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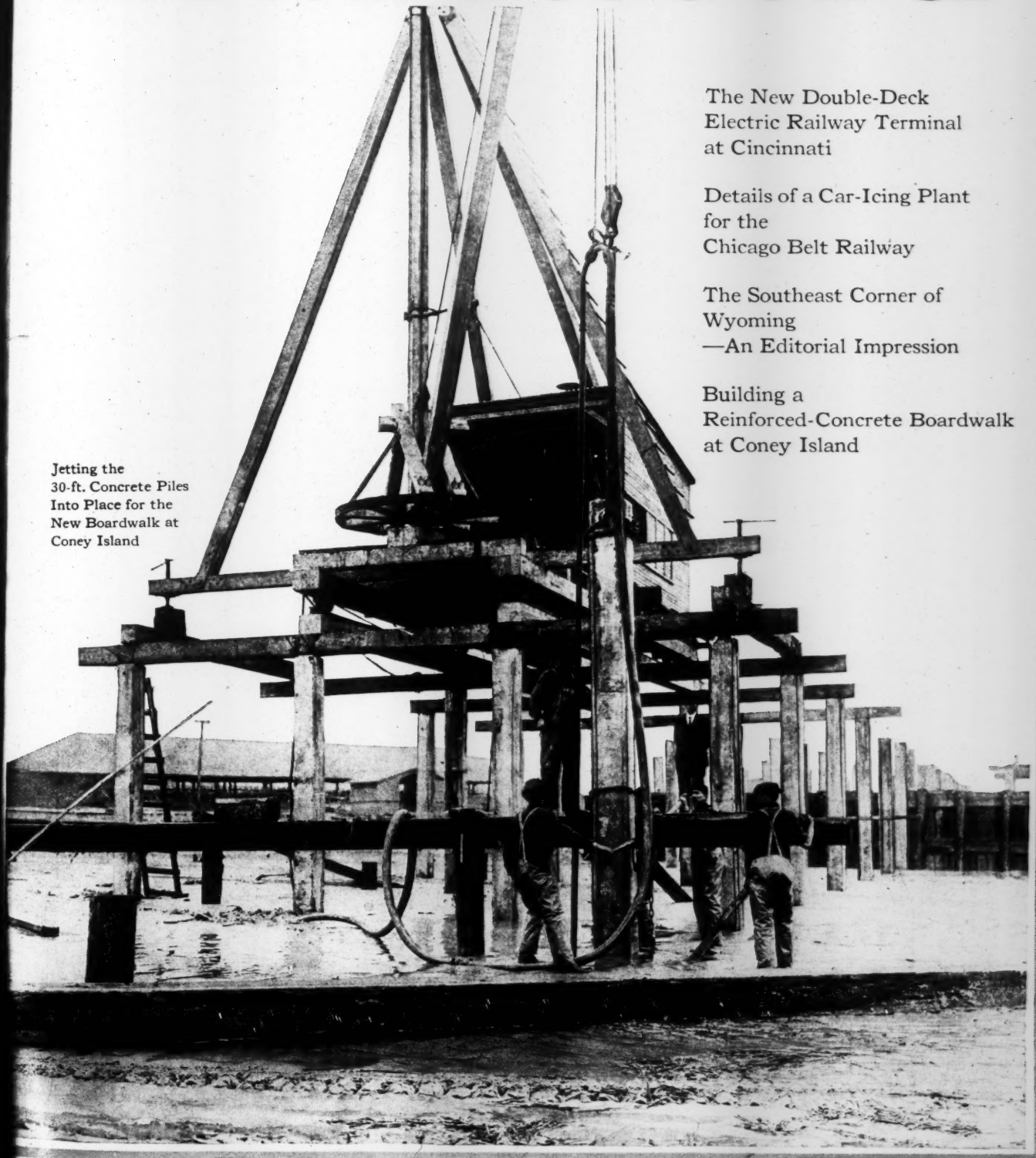
August 10, 1922

# Engineering News-Record



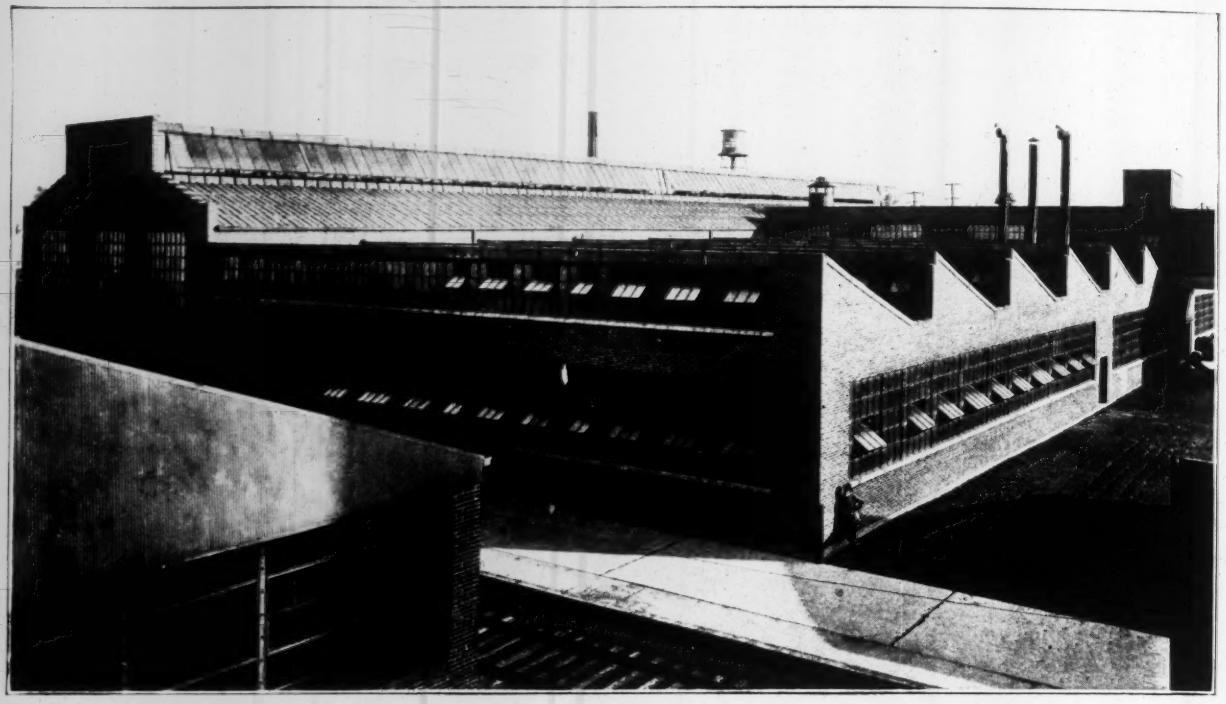
Jetting the 30-ft. Concrete Piles Into Place for the New Boardwalk at Coney Island

The New Double-Deck Electric Railway Terminal at Cincinnati

Details of a Car-Icing Plant for the Chicago Belt Railway

The Southeast Corner of Wyoming —An Editorial Impression

Building a Reinforced-Concrete Boardwalk at Coney Island



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# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, AUGUST 10, 1922 — Number 6

## Criminal Negligence Hard to Prove

TIME and again it has been shown that it is well nigh impossible to punish any one for criminal negligence in building failures. The law's delays and technicalities usually serve to shift the onus of blame, or the requirements of proof are too rigid to permit successful prosecution. In three recent cases this has been found to be so—the dismissal of the first indictments against the various men connected with the Knickerbocker failure in Washington, the release of the owner of the Ferris wheel which blew down in one of New York's suburbs early in June and the exoneration by a coroner's jury of those concerned with the collapse of the Parkway Building in Philadelphia—which partly failed during reconstruction last month. Something more than the ordinary processes of law is required to guarantee punishment for building collapses.

## Invidious Financing

THE senatorial minority report on Muscle Shoals noted in the news columns is one of the most naïve documents ever signed by public men. In effect these senators admit that most of the features of the Ford offer are reprehensible but they offer in defense that it is Henry Ford who is going to do these things and he can do no wrong. Most naïve of all is the defense of the sinking fund theory of payment for the use of government property. Why not carry this to its logical conclusion and solve the whole fiscal problem of government and taxation? Let the government borrow as much money as it needs at 3½ per cent and loan it at 4½ per cent. The increment could be used to run the country. Or do the senators and Mr. Ford think this fiscal method should be applied only to his activities?

## Interstate Sewage-Works Zoning

INTERSTATE stream pollution control can best be effected by co-operation between the state authorities having jurisdiction on either side of the waters concerned. The Pennsylvania and New Jersey state health departments have given practical recognition to this fact and adopted a joint policy for their guidance in passing on plans for sewage-works along the Delaware River. This agreement is significant not alone as an instance of interstate co-operation in this field but also because it sets up different standards of sewage treatment for successive reaches of the river, varying with the uses to which the water is put. In other words, an interstate sewage-works zoning plan has been worked out by the engineers of the two state health departments and adopted by the departments, as detailed elsewhere in this issue. The agreement deserves careful study by every state department having control of sewage-works and stream pollution affecting interstate waters. Similar stream zoning is also desirable for waters wholly within a single state. Something of the kind is practiced by well-administered state health departments generally but few if any of them have reduced the practice to as clear-cut statements of policy as those adopted by Pennsylvania and New Jersey for the control of sewage-works on the Delaware. The fact that the Pennsylvania-New Jersey policy is not based on analytical standards is notable.

## The Bates Road Tests

THE sixth and final run of traffic over the Bates experimental road is now being made under the direction of the Illinois State Highway Department. As each run has been completed the Illinois officials have issued a bulletin embodying observations on the condition of the 63 test sections into which the 2-mile road is divided. To date five bulletins have been issued and the data they contain is summarized elsewhere in this issue. So much interest has been manifested by highway engineers in the Bates road tests that a progress statement covering the observations to date will be widely studied. It should be understood, of course, that nothing in the way of final conclusions has as yet been issued by the Illinois department and that pending the completion of the final traffic run and an analysis of results made with a full knowledge of local conditions, judgment as to the relative merits of the various types of construction should be withheld. Involving a cost of $300,000 or more, the Illinois work constitutes one of the country's most important programs of research and has been the objective of inspection trips by hundreds of engineers and highway officials from other states. The mere fact that a certain section is recorded as a "failure" under a certain increment of traffic means nothing without a full understanding of the conditions which governed the construction of the section and the conduct of the test. The results published in this week's issue, therefore, should be viewed in the light of a progress report rather than as a source of data on which to base conclusions.

## Simple Precautions Against Sea Water

THE Coney Island boardwalk, illustrated on another page, will not be directly over the ocean so that its concrete piles are not subjected to the alternate wetting by sea water and drying out during the out tide. It is, therefore, not in the critical location of the many similar concrete structures whose deterioration may be laid to direct sea water attack. A near-by municipal bath house, however, was equally removed from contact with the water but this did not save its reinforced-concrete members from breakdown that required extensive repair. With certain kinds of concrete, therefore, ocean exposure at Coney Island is dangerous. It remains to be seen whether the precaution taken in the new boardwalk will suffice. These precautions are simple—merely the greatest of care in mixing and placing the concrete, the use of a rich mixture and the covering of

the steel by at least 3 in. of concrete. The boardwalk is low and adequately braced that it will not suffer from the vibration that probably hastened the cracking of the high unbraced piers on the California coast and the workmanship on it is good. Five years from now an inspection of it will show whether some special panacea is required to make reinforced concrete stand up in sea water moisture.

### Not in the Contract

CONTRACTING can be reduced, in instances, to a thorough business arrangement wherein only known factors enter. Clear specifications; amity, not enmity, between contractor and engineer; delivery of materials and prosecution of the work in accordance with preconceived plans; and absence of unforeseen difficulties; all these minimize the chance of the contractor's failing to make a profit. Under such conditions administration, superintendence and the personal element usually determine the margin of profit. But the perfect contract is rare. Besides, many contractors, particularly of the old school, are in the business because of the indeterminable factors entering particular contracts. The wagering instinct is strong in all humans and satisfaction of it is found by some in the contracting business. In the construction of the Coney Island boardwalk a new factor entered—a factor which easily could have been overlooked by the bidding contractor as being necessary to cover as a "contingency." The work has reached its peak during the height of the summer season. A hot day at Coney Island means a seething mass of humanity stretched along a mile or so of beach of an average width of around 100 ft. Jetting piles is a process watched by the curious thousands kept out of harm's way by police. Inability to secure access to the work at the most convenient points makes it necessary to drag concrete piles by tractor a maximum distance of 1,000 ft. Details concerning the difficulties the contractor must face in working with armies of men, women and children at his figurative elbow are unnecessary. Anyone who has been to Coney Island on a hot August afternoon can visualize them. But the fact remains that they are difficulties probably unaccounted for in the contract.

### A National Engineering Museum

IN last week's issue we announced a movement, under the auspices of the American Society of Mechanical Engineers, to establish a national engineering museum at Washington. Doubtless the proposal will stir the imaginations of engineers throughout the land, largely because of the sentimental values involved. From the very fact that a museum must be located at one place the educational values are not quite so obvious. But having at the national capital an engineering shrine comparable with the South Kensington Museum, the Paris Conservatoire des Arts et Metiers and the Munich Deutches Museum must impart to the professions of applied science a consciousness of public appreciation that would be decidedly stimulating. The educational value of such a museum could be greatly enhanced by the compilation of a well-illustrated descriptive catalogue for distribution to technical reading-rooms, libraries and schools. Such a plan would bring about a more general acquaintance with the collection and would broaden its usefulness, promote its popularity and insure its support and development. This may seem to be but a detail to be considered later when the museum is a going concern. Perhaps it is. But we suspect that the announcement of such a purpose would help to win many valuable specimens from their present custody and otherwise further the project in its earliest stages.

### An Intellectual Famine

MOST of us think of Russia in terms of peasants. When we picture to ourselves the woe that has come to that stricken land we see starving Moujiks and their famished children. So our charity has been directed toward keeping alive the spark of bare animal life. This work has been well done, and now Secretary Hoover tells us that the danger of famine is past. But now and then *Engineering News-Record* receives evidence that still another famine remains to be fought, not only in Russia, but also among other war-ridden peoples. A case in point is the letter of M. Stroganoff, which appears elsewhere in this issue. Another is found in an appeal recently received from a Russian professor of civil enginering who, through three dire years, has carried on his courses under most disheartening handicaps. He now bespeaks aid to print his texts for the benefit of his students, a step that hitherto has been beyond his means or those of his school. From Germany, too, comes a voice appealing for help to bring up to date the shelves of technical libraries. Now that the needs of the flesh have been met, we may with propriety turn to a consideration of the intellectual famine. In Russia, Germany, Austria, Poland—throughout eastern Europe, indeed, men of science have perforce subordinated their intellectual hunger to the physical needs of their compatriots, while their zeal has kept burning the lamp of scientific investigation and education. Prof. Winslow's request deserves more than a casual reading by those who may be in position to help.

### Building Code Experts

NEW YORK STATE is to have a standard building code and, at the bidding of the legislature, the state industrial commissioner has appointed a committee, the chief purpose of which, according to reports, is "to lay down minimum standards of safety in the construction of motion picture theaters and other places of public assembly in order to prevent catastrophes such as those which occurred last winter when motion picture theaters in Brooklyn and Washington collapsed." Those two failures were due to structural insufficiency, which would not have occurred if the proper principles of structural engineering had been followed. A code intended to avoid such conditions should naturally be prepared, at least in part, by engineers, but who did Commissioner Sayer place on the committee? Labor leaders, actors and theatrical men, a health officer, a policeman, an illuminating engineer, a hotel man, two architects, two insurance men, and five building officials. Not one of these men, with the possible exception of the building officials, is competent even to pass upon the structural requirements of theaters, much less to establish such requirements themselves. Albany would appear to be a good place for engineers to start a campaign of public information as to the service the engineer can render the world.

## Individual or Group

WITH many engineers and engineering societies it has become a favorite literary and oratorical sport to complain about the reluctance of the community to accord to the engineer his "rightful position of leadership" and to assume that this position can only be won by group action accompanied by abundant publicity. In this enthusiasm for concerted thought and performance there is danger that the individual's duty and responsibilities will be forgotten; if it is, there will be lost one of the most powerful agents of benefit to the profession and to the community.

Leadership is not a right; it is a power. In a democracy it is not bestowed upon a class or a group; more often it is gained by the individual through capacity to inspire confidence and to serve effectively. However numerous and all-pervading our societies, however eloquent our spokesmen, and however prolix our press-agents, engineers will not be acclaimed by the community because we "tell the world" how good we are. The leadership in public affairs that may be attained by the profession will after all be neither greater nor less than the aggregate leadership attained by the individual engineers that compose it.

Frequently we hear peevish outbreaks because lawyers seem to be preferred to enginers as leaders in public affairs. Lawyers do not become leaders *because* they are lawyers. They lead in public affairs, first of all, because they participate in public affairs. That, of course, is not the whole story. If they are to become leaders they must do more than merely participate. But at this very first step most engineers fall down.

How many engineers take an active part in the affairs of their communities? How many, for example, are members of their local Chambers of Commerce or of the other community organizations that interest themselves in public affairs? How many, in other words, even expose themselves to leadership? Some do, of course. The column "The Engineer in Public Life" in each issue of this journal is testimony of that. But the number is still too few, though our observation has been that when an engineer does show enough interest in public affairs to participate in works of this sort he is welcomed eagerly, and once he has gained the confidence of his lay associates his counsel is sought and he is quickly accorded such measure of leadership as his merit justifies.

Engineers can bring to their communities a vast deal of helpful and efficient service. We are inclined to agree with the comment of Professor Dunlap on another page of this issue that most engineers find it difficult to speak well or write well but we are unwilling to subscribe to his conclusion that they cannot think well. We believe that most engineers can think mighty well along the line in which they have been trained. But so much of his thinking travels the undeviating tangent of scientific truth that the engineer often skids mentally when he tackles the twists and turns of human nature. But if he is to take "his rightful place of leadership" this is the road he must learn to travel with confidence, speed and security.

Because of this disability and his difficulty in writing and speaking well, it happens frequently that the engineer is a poor salesman of his ideas. But this is an individual defect that must be cured in the individual. As Professor Dunlap suggests, his education can be designed to help him more than it now does. It can broaden his interests, teach him something of his relation to the industrial world in which he must work and give him a start in the art of writing and speaking well. But if he is to become the well-rounded man he must be to rank as a leader among his fellows he must develop these faculties by contact with his fellow men and by participation in community affairs to the limit of his time and ability. And he must do it himself. Obviously, dependence on the engineering society or the society press-agent is not going to strengthen his powers in this respect. If the engineer is going to swim in the sea of public affairs he must jump in himself.

If every engineer who thinks his profession should participate more actively in public affairs would join and take an interest in his local organization that deals with public affairs, the profession could exert more honest, constructive influence on the public welfare than in any other way. We might not get the word "engineer" on the front page of the newspapers as often as we could by going it alone with the aid of a press-agent; but such notice is ephemeral and of doubtful worth. A year of it will be outweighed in solid value to the profession by the intelligent service of one engineer on some public committee together with the lawyers, bankers and business men of the community. The value of such association to the individual engineer goes without saying.

## The Seniority Issue

LAST week the railroad operators rejected the President's proposal for the settlement of the railroad strike. They objected to the restoration of seniority rights to the strikers as against the employees who remained at work and the new men employed.

To our mind the operators had to act as they did. The President has placed too small importance on the seniority issue. It is true that no additional compensation is involved. High seniority rating merely gives the right to select the better jobs, day in preference to night work, etc. Nevertheless, these are substantial advantages in the minds of the men—evidenced by the very fact that the strikers have held out against settlement until their seniority was restored.

But there is more involved than the value to the individual of the seniority rights. If the railroads were to submit to the President's proposal they could never again in case of a strike get employees to stay on their jobs or induce worth-while men to take the strikers' places. Only ne'er-do-wells would take jobs limited to the duration of the strike.

In this case there was clear warning to the shopcraft employees that they were jeopardizing their seniority rights. The chairman of the Railroad Labor Board warned them that they would lose their seniority, and that the men who remained in the service and those now entering it, would have rights "that the board could not ignore." With this warning, with the obvious justice of rewarding those who remained in the service and of assuring permanence to those who took the strikers' places, with the value placed upon seniority by the strikers themselves, we see no other alternative for the railroad executives than to reject the President's proposal.

As Woodrow Wilson said in one of his war messages "The right is more precious than peace."

# Cincinnati Double-Deck Terminal for Electric Lines

**Viaduct to Ohio Bridge — Concrete Station and Office Building — Structural Details — Over 1,400 Cars Daily Removed from Congested Streets**

A DOUBLE-DECK terminal for interurban electric cars as an annex to a large office building, with a main passenger approach through an arcade in this building and with a viaduct connection from the upper floor to the Covington bridge over the Ohio River, is a recent development in the local transportation service at Cincinnati, Ohio. Both buildings are of reinforced-concrete construction except for steel framing where the track

FIG. 1. DIXIE TERMINAL BUILDING, CINCINNATI, OHIO, WITH ARCADE ENTRANCE TO STATION

layout necessitates an unsymmetrical spacing of columns. Concrete footings of the spread and cantilever types in a sand and gravel formation constitute the foundation. Fig. 1 is a view of the main front of the building and Fig. 2 shows the two new viaducts flanking the bridge approach. Two electric lines operated by the Cincinnati, Newport & Covington Street Railway Co. on the Kentucky side of the river enter Cincinnati over two separate bridges. These lines serve the cities of Newport and Covington and several outlying towns. Originally the cars looped over a portion of the Cincinnati street railway system and thus added to the traffic congestion in the business district. With the opening of the new terminal in October, 1921, these cars are kept clear of the congested district and avoid all interference with the city cars. A proposed development is to bring the interurban line of the Cincinnati, Lawrenceburg & Aurora Electric Ry. into the new terminal. This will involve a 6½-mile extension including about a mile of elevated line.

In the layout of the terminal, a sidehill location on ground sloping up from the river facilitates a separation of grades for the line over the Covington bridge, as shown by Fig. 3. Thus there is a difference of 28.64 ft. in elevation in the 400-ft. block between Third and Fourth Sts. At the corner of Walnut and Fourth Sts., is the north section or office building, 142 x 231 ft., with nine stories in front and ten at the rear. Through this building extends a handsome arcade 25 ft. wide and 34 ft. high which is lined with shops and forms the main approach to the terminal station in the south section or annex of the building. This annex is 139 x 183 ft., four stories high, with tracks on the first and second floors. Stairways from the end of the arcade at the first floor or Fourth St. level of the office building lead down to the second floor of the terminal, which has also a side entrance on Walnut St.

Directly opposite the terminal is the Covington suspension bridge which has along each side a car track isolated from the roadway. Formerly these tracks swung into the roadway on the Cincinnati approach and continued down this incline to connect with the street car tracks on Third St. Two short single-track viaducts have now been built by the Covington & Cincinnati Bridge Co. to divert these bridge tracks from the approach roadway and carry them over Third St. into the second floor of the Dixie Terminal (see Fig. 2). The Newport cars cross the Newport or Central bridge about half mile eastward and run on Third St. to the terminal, where they enter the first floor. This arrangement is not objectionable since the street is outside of the congested district. Fig. 4 shows the layout of the two terminal floors.

*Structural Features of Office Building*—Floor construction in the main building is of the long-span cored or ribbed type, using gypsum floor tile as cores. The panels vary from 18 x 26 ft. to 18 x 40 ft. in column spacing and the floors are designed for a 50-lb. live-load.

Above the third floor the office building is L-shaped with girders spaced 18 ft. 4 in. c. to c. running lengthwise of the short leg and crosswise of the long leg. In the former there are four girder spans of 41, 26 34 and 39 ft., while in the long leg they are about 41 and 26 ft. In order to reduce the dead weight of the structure the ribbed concrete floor with gypsum tile between the ribs was adopted. Since the width of the upper or compression flanges of the concrete girders was reduced towards the end supports in an approximate parabolic curve the tile fillers start nearer and nearer to the stem of the girder, as shown in Fig. 5. The rib in the center of the panel parallel with the main girders is intended as a distributing or bridging rib to take care of the possible overloading of one or several of the cross ribs.

An attic slab just below the roof is suspended from the roof girders by means of hangers incased in concrete, in order to reduce the span and consequently the size of the attic floor beams so that they would project but slightly below the ceiling. This is shown by the cross-section of the longer leg of the building in Fig.

6. In the longer span the inverted type of attic beam was used so as to obtain a flat ceiling. The floor below this part of the attic is to be used for a large assembly or club room and an extra high ceiling was required on this portion. The portion at the right indicates the general ceiling height for the story below.

In the design of this structure one system of four beams across the whole building was adopted, with the columns above and below as part of the structure. The theory of least work was the method employed in determining the moments and shears for various manners of loading and the results were checked by the slope deflection method indicated in Faber & Bowies book. Since long-span girders and comparatively low story heights caused quite a little induced bending in the end columns the stresses in these were considered with great care. In the case of the roof girder where the story height was very low and no column above the roof to assist in taking the bending it was found impracticable to design a column to take care of this condition. This difficulty was met by haunching the girder bearing down to the attic, where a slip joint was provided, as shown in Fig. 6. When the forms were removed the movement at this joint was approximately what had been anticipated of the structure.

*Structural Design of Terminal*—Three methods of floor construction are employed in the south or station building, which is four stories high and is shown in section in Fig. 7. In general the flat-slab system is used with two-way reinforcement and panels 25 ft. 4 in. x 27 ft. Along the east side, however, the beam and girder system was used since the track layout on the two lower floors made is necessary to eliminate one row of columns. This portion of the building has beams 37 ft. long and bays 25 ft. 4 in. x 37 ft. are divided into three panels by beams spaced about 8½ ft. c. to c. This construction is designed for a live-load of 341 lb. on the track floors and 60 lb. on the two upper floors.

Along the loop of the car track the regular spacing

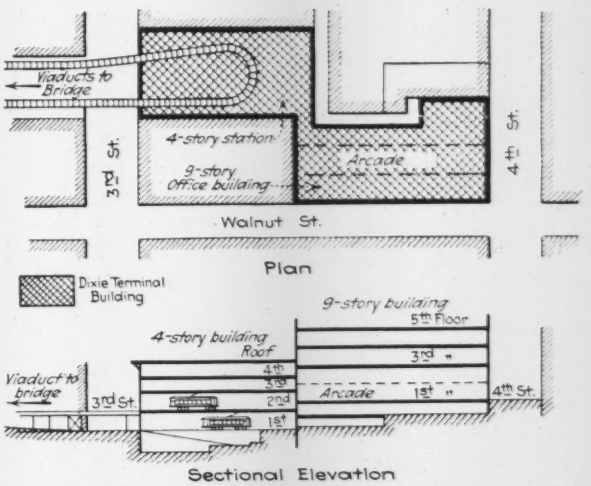



FIG. 3. LAYOUT OF DIXIE TERMINAL AT CINCINNATI

of the columns in the upper floors could not be maintained (Fig. 4). To meet this condition steel columns located to suit the track arrangement carry steel girders in the third floor framing to support columns of the third and fourth floors (see Fig. 7). These steel columns and girders are cased in concrete.

Considerations of headroom and deflection restricted the design of these steel girders. Since the large concentrated load from the supported column caused high shear in the girder a box type of girder was resorted to, with triple webs in some cases. Deflection became an important factor as the third floor was completed before the structural work for the floors above was started. As this work would continue, the bases of these girder-supported columns at the third floor line would settle more than the adjacent columns not supported on girders. This would have the same effect as columns settling unequally and would result in unsightly cracks. To meet this condition the flanges of the girders were

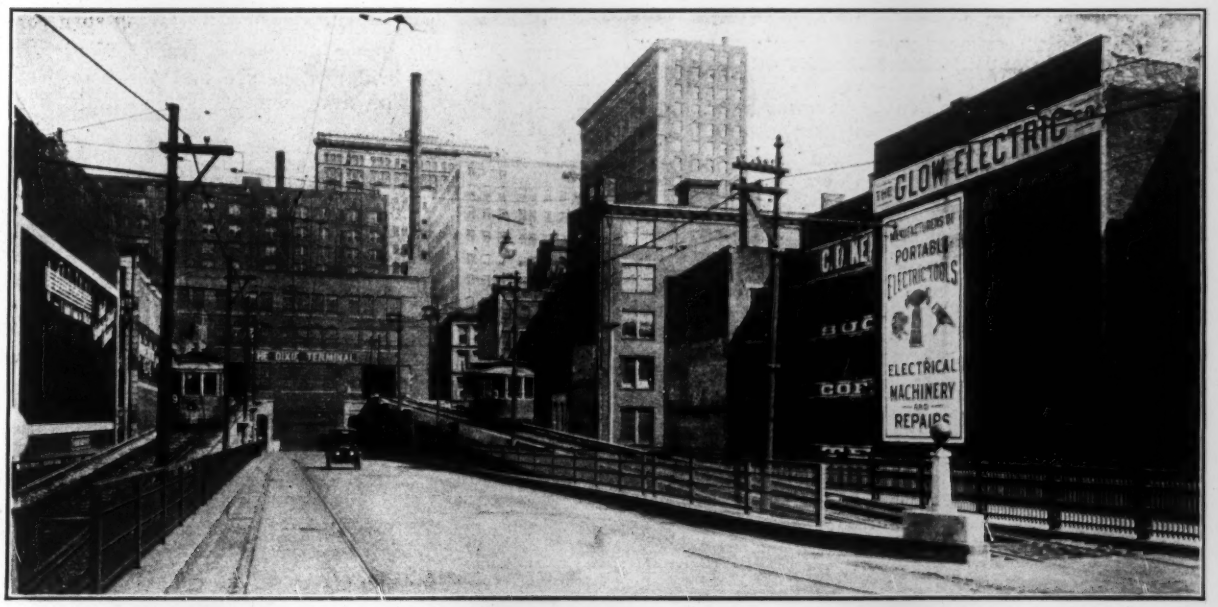



FIG. 2. CAR APPROACH TO UPPER DECK OF TERMINAL

**Roadway and old tracks descend from bridge to Third St. New viaducts ascend to pass over street into station.**

designed with a low extreme fiber stress so that the deflection would be comparatively small.

Track openings in the south wall at the first floor are 28 ft. 8 in. and 17 ft. 6 in. wide, with a height of 16½ ft., those on the second floor are 17½ and 14 ft. wide with a height of 14½ ft. The extra width of one opening is due to the diagonal location of the tracks.

Freight and express matter for tenants of the office building are delivered in the basement of the station building, thus relieving the streets of an obstruction to traffic. This basement is reached from Third St. by a concrete incline 23 ft. with a grade of 17½ per cent, as

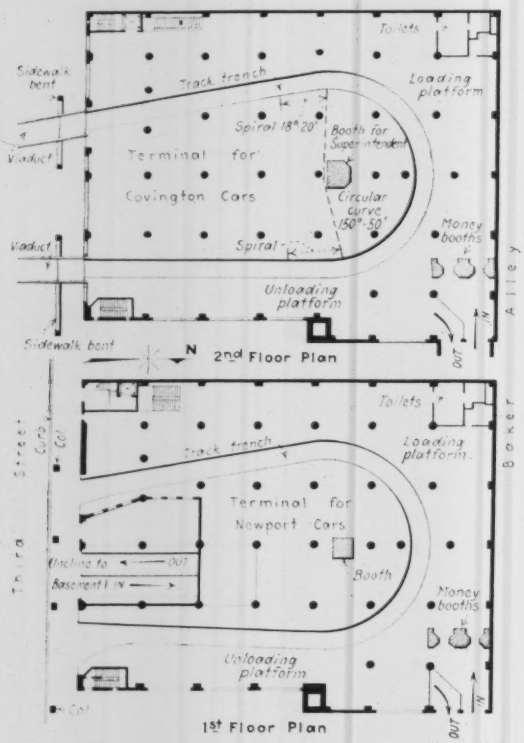



FIG. 4. LOOP TRACKS NECESSITATE UNSYMMETRICAL COLUMN ARRANGEMENT

shown in Fig. 7. It has a double driveway and the doorways are fitted with rolling steel shutters. Motor trucks and wagons deliver goods on a platform from which they are distributed to the elevators or other parts of the building by a small electric truck. In this basement also are the coal bunker and power equipment for the two buildings.

*Viaduct Approaches*—A special problem was involved in providing the viaduct connection between the second floor of the terminal and the approach of the Covington bridge. Originally the approach ended at

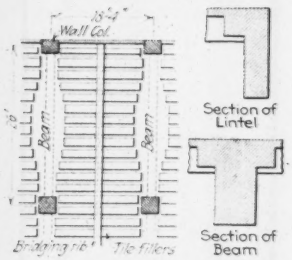



FIG. 5. BEAM AND RIBBED SLAB FLOOR

Second St., but as this level was flooded during high stages of the river a viaduct was built to extend the approach to Third St. but retaining an inclined roadway from Second St. This improvement which was completed in 1918, involved raising the grade of the old structure for about 225 ft. and building 737 ft. of steel viaduct. Three-column bents carry a 30-ft. roadway and brackets carry the sidewalks, the total width being 51 ft. except where a 12-ft. offset is required by property lines.

This bridge approach is not in line with a city street but is faced by a block of buildings on Third St., in which the new terminal station is located (see Fig. 3). Of several plans prepared to carry the bridge cars over this street into the terminal the cheapest was to build two single-track viaducts outside of the approach, but this would have necessitated leading the tracks across the sidewalks, which was objectionable. In the adopted plan, track viaducts on an ascending grade to the north are built outside of the roadway and each carries on the outside a sidewalk on the same descending grade as the roadway. From Second St. the roadway was widened, thus improving the track layout and largely eliminating the effect of the offset at this point. The general arrangement is shown in Fig. 8.

Each single-track viaduct is about 527 ft. long, including 253 ft. of plate, girder construction over streets and three intermediate sections of reinforced-concrete (see Figs. 8 and 9). This combination was adopted partly on account of a slight saving in cost and partly on account of appearance. At Third St. the steelwork is cased in concrete as the city authorities considered that this would improve the appearance (Fig. 8).

*Steel Viaduct Construction*—Special design was required for the steel portion of the viaduct adjacent to the terminal, the location of columns and girders being governed by the upper and lower track layouts, the lines of the old bridge structure and the street and building lines. The arrangement is shown by Figs. 8 and 10.

In each viaduct there is a bent on the north curb line of Third St. and a 20-ft. tower of two braced bents south of the street line, with a 67-ft. girder span over the street and a short span into the terminal. An unsymmetrical arrangement is required in the west tower, each bent being anchored to a grillage of four 24-in. I-beams cantilevered on footings kept within the property line. The floor beam of the north bent is also cantilevered over the roadway. In the east tower the columns rest

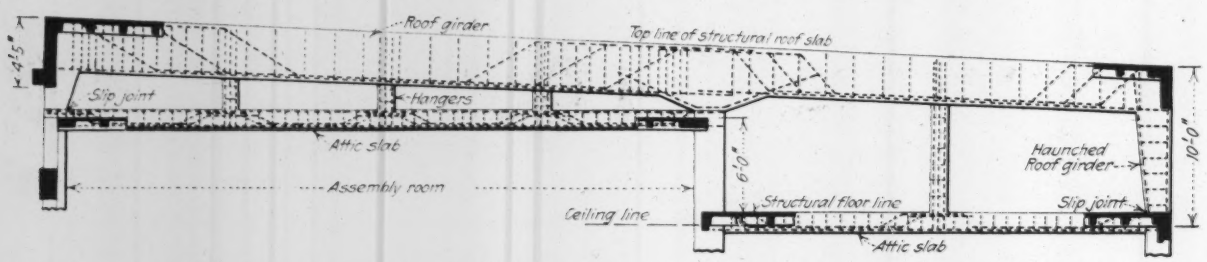



FIG. 6. SPECIAL ROOF CONSTRUCTION WITH WALL COLUMN FORMED AS PART OF GIRDER

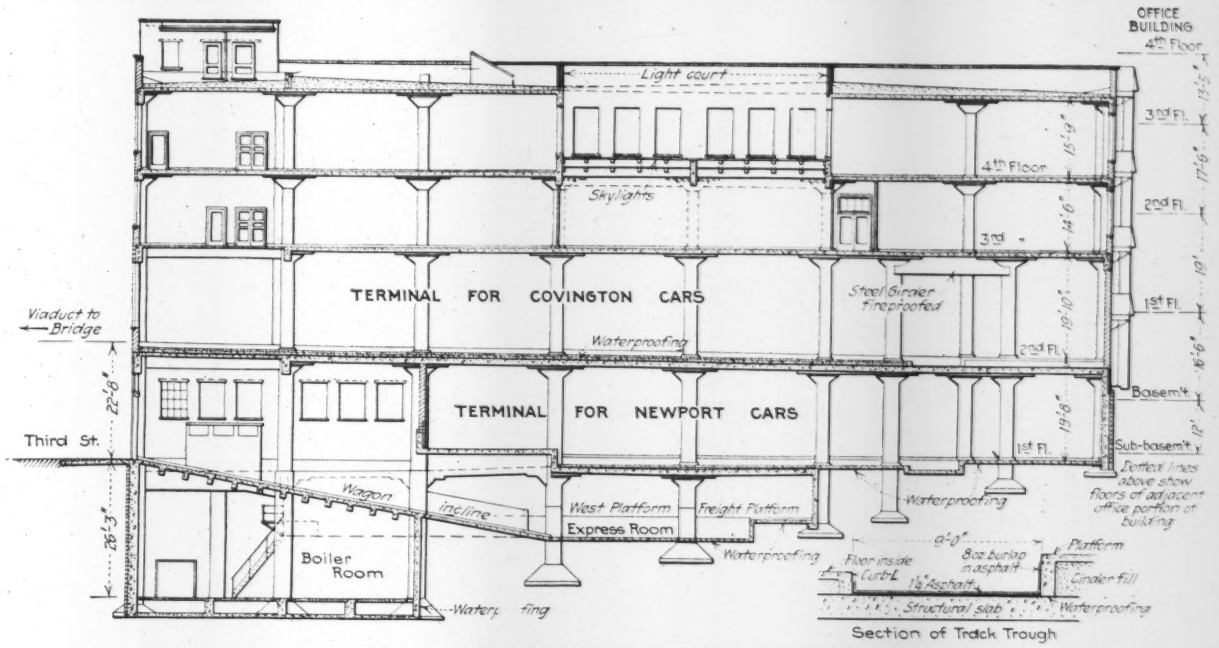



FIG. 7. CROSS-SECTION OF TERMINAL BUILDING

directly upon the concrete footings and although the track girders are placed unsymmetrically no overhang or cantilever is required. Both bents of this tower are practically the same, except that one has the doorbeam reinforced by extra stiffeners under the seats for the Third St. girders.

*Concrete Viaduct Construction*—In the first two concrete sections south of Third St. the west viaduct has two-column bents, as shown in Fig. 11. The columns support a track trough of slab and curved beam construction, and also sidewalk cantilever brackets connected by beams carrying a 4-in. slab 8 ft. wide. As the outer sidewalk line is generally within about 2 in. of the adjacent building the bracket support was adopted to avoid underpinning the foundations of these walls. The two columns rest on piers supported by a single footing. In the last section on the west side, where the grade reaches that of the original structure, the two-column bents support a floor of slab and beam construction with the slab continuous under the track and sidewalk. The columns rest on separate footings. Owing to the proximity of adjacent foundation walls, the floorbeams are cantilevered to partially support the sidewalk, which consists of a 4-in. slab on a cinder concrete fill.

In the east viaduct the bents in the first two concrete sections are of the three-column type supporting the track trough or deck and a sidewalk floor beam (see Fig. 11). The beams are connected by stringers carrying a 4-in. slab 10 ft. 4 in. wide. The two columns supporting the track trough rest on piers built on a single footing, but the outer column rests on a separate footing. The last section of the east viaduct is of the two-column slab and beam type as on the west side, except that the floorbeams are not cantilevered. In all the concrete sections the bents are about 18 ft. c. to c. and stagger the bents in the old structure.

A 1:2:4 concrete mix was used throughout, except for a richer mix in the casing for the steelwork on Third St. All piers and bottom slabs in footings are reinforced. Bottom slabs supporting two piers are reinforced top and bottom. The piers are connected with the columns by stubs or dowels. Main columns are generally 28 in. square, reinforced with ¾-in. square rods and ⅜-in. square hoops placed 12 in. c. to c. Beams are generally reinforced top and bottom and a liberal use of hooked ends is made. Shearing stresses are generally taken care of by stirrups. In the first two sections in each diversion the sidewalk stringer next to the column is made heavier and liberally reinforced

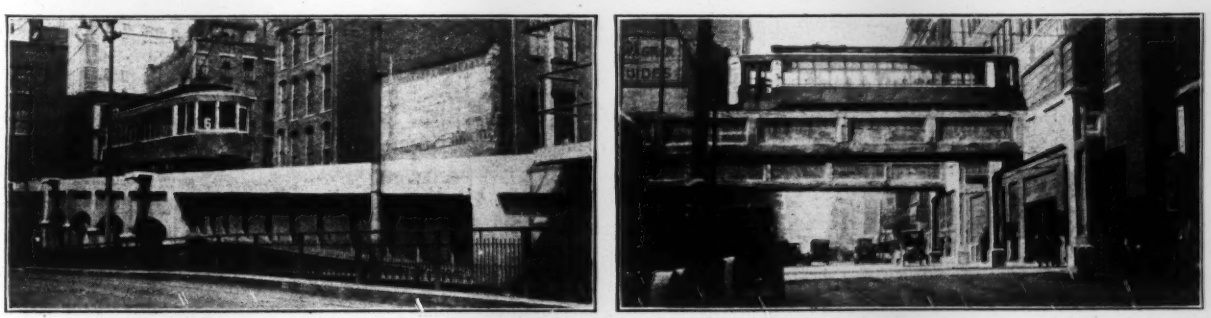


FIG. 8. VIADUCT TO BRIDGE APPROACH

Left: Steel and concrete spans with concrete deck. Right: Two single-track concrete-cased steel spans over Third St.

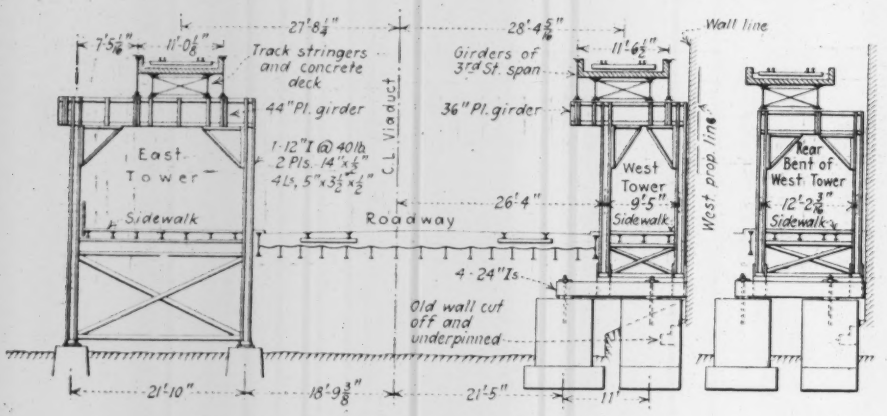



FIG. 10. CROSS-SECTIONS OF STEEL VIADUCT

with steel well anchored to the extreme columns to take care of temperature and braking stresses.

The last concrete section in each viaduct is at the grade of the old steel structure and is built against the steel curb girders of the latter. These girders were reinforced by new girders riveted under them and their tops were cut off to allow of the floor connection. South of the new concrete sections the old steel structure was widened by a triangular section on each side (see Fig. 9). On the east side this necessitated the removal of a 42-ft. curb girder over Second St. and its replacement by a new girder of less depth. During this change the old steel framing was supported by a 60-ft. girder on cribbing. This girder was eventually placed at the curb line of the widened roadway.

*Viaduct Loading.*—Live-loads were used in the calculations as follows: On sidewalks, 100 lb. per square foot; on diversion viaducts, three 50-ton electric cars; on roadway, three 50-ton cars on each track and a 24-ton road roller or 100 lb. per square foot. Stresses arising from centrifugal forces, temperature, braking and wind were also taken into account.

Rectangular frames of steel and concrete were treated as elastic structures with rigid joints. Soil pressures from vertical loads are generally about 3,500 lb. per square foot and the footings of the concrete portions are arranged to secure a practically uniform loading under dead load. The steel superstructure is in accordance with the bridge specifications of the Ohio State Highway Department.

*Deck and Track Construction*—All the tracks are on the Cincinnati gage of 5 ft. 2½ in. The terminal loops have a radius of 45 ft. 6¾ in. on the center line, with spirals of the Lorain type to connect the circular curve with the tangents. These terminal loops are shown in Fig. 4. A reinforced-concrete track trough supported by the longitudinal girders of the viaduct is 9 ft. 8 in. wide inside and 17 in deep, with 8-in. curb walls and 12-in. slab, except that on the steel sections the slab is 9 in. thick. No waterproofing was used, reliance being placed on securing a good quality of concrete with a sidewalk finish. The trough is drained by 4-in. pipes placed about 35 ft. apart.

In the building the platform or floor outside of the track is level with the top of rail, but on the inside of the loop the floor is 12 in. lower (see Fig. 7). The finished concrete floors are raised above the structural slab by a cinder fill. On the curves the track trough is widened to give the necessary car clearance.

Track construction consists of 100-lb. T-rails on ties 8 x 6 in., 8 ft. long, on 6 in. of stone ballast along the viaduct, but gravel ballast with a large proportion of sand is used on the loops in the station. On the upper loop and the Third St. spans both rails have bolted T-rail guards, but on the remaining portions of the viaducts the guards are 100-lb. T-rails spiked to the ties. At the foot of the grade from the terminal the new tracks have switch connections with the old tracks on the bridge approach. These latter tracks have 7-in. girder rails on wood ties embedded in the concrete base of the granite roadway paving.

On the lower loop the track construction is similar to that on the upper deck. Special trackwork of the heavy girder type in Third St. in front of the terminal connects the loop with the new double-track line in this street to the Newport bridge. Connections are made

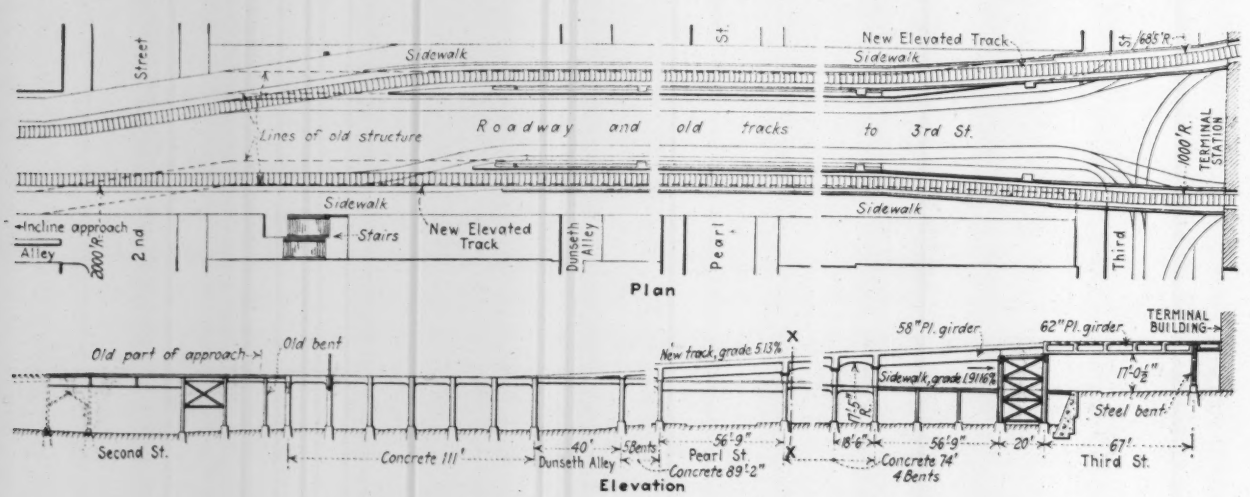



FIG. 9. VIADUCT FOR CARS TO COVINGTON BRIDGE

also with the old tracks on the bridge approach, so that in an emergency the Covington cars may be diverted to the lower-deck loop.

*Engineers and Contractors*—The buildings and terminal layout were designed for the Dixie Terminal Co. by Barber & Woodward, architects, Cincinnati, with Theodore Green, Buffalo, N. Y., as structural engineer. Harry C. Reely was superintendent in charge for the architects. Walter G. Franz, Cincinnati, planned the mechanical equipment. The contract for the station building was let to the H. Harig Co., of Cincinnati, and for the office building the Ohio Building & Construction Co.

The diversion viaducts were designed for the Covington & Cincinnati Bridge Co. by Clifford N. Miller, consulting engineer, Cincinnati, who had designed the previous alteration to the bridge approach and who

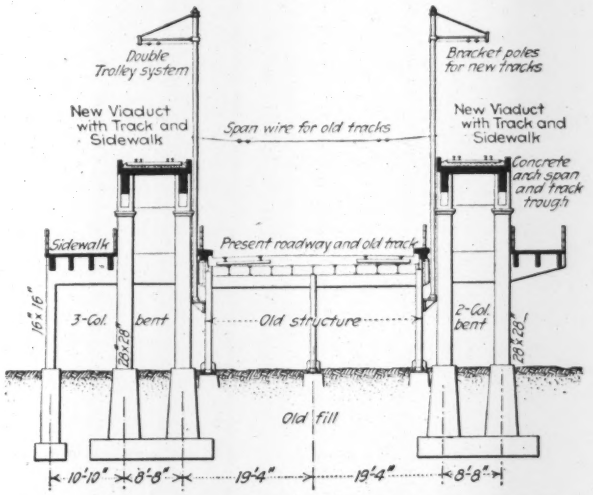



FIG. 11. CROSS-SECTIONS OF CONCRETE VIADUCT

supervised the execution of the work. Steelwork was fabricated and erected by the American Bridge Co. All concrete work was done by the Ferro Concrete Construction Co., Cincinnati.

The first car entered the terminal on Oct. 27, 1921. The daily traffic includes 786 Covington cars and 638 Newport cars. In March, 1922, the total number of passengers carried out of both terminals averaged 31,605 daily. There is no method of registering the number of people carried into the terminal but it is assumed to be about the same as the outbound passengers, making a total of approximately 63,210 passengers daily. These figures are given by W. H. Harton, general manager of the South Covington & Cincinnati Street Railway Co.

## Power Plant Under Construction at Quito, Ecuador

Installation of a new power plant has been begun by the Quito Electric Light & Power Co., the operation of which is to commence in November. The plant is located in the Chillo valley and will develop 3,000 horsepower. Equipment is being purchased in the United States. The falls which the company is utilizing are capable of developing a total of 6,000 horsepower. It has been suggested that the government might find it advisable to use this electric power to operate the Quito-Ibarra R.R., as the supply will be sufficient for this purpose.—*Commerce Reports.*

## Commerce Department Reports American Ties Used on Chinese Railways

*Abstract of report by Frank Rhea, U. S. Trade Commissioner at Peking.*

THERE are both present and future possibilities for American railway ties in China. Although steel and concrete are used, the demand is mostly for wooden ties. Concrete ties are quite satisfactory on a well-ballasted railroad like the Canton- Kowloon, which runs through a territory not subject to freezing, and therefore has no heaving of track in the winter to cause breakage, but such ties are entirely too expensive to compete with imported wooden ties. On the Canton-Samshui Ry., a Belgian steel tie has been used which, although expensive, has been reasonably satisfactory, especially as this railway has light traffic and wheel loads. The meter-gage Yunnan Ry., is all laid with steel ties. The Shantung Ry., was originally laid with steel tie of German design, but many of these were removed during the Japanese administration and replaced with wooden ties.

*American Timber Used*—Northwestern American and Canadian timber is used and is reported to give better results than either the Japanese or Manchurian timbers. In South China, however, the Australian, Indian, or Philippine hardwoods are said to give better service. This is because the wood resists white ants, which are very destructive to ties in that section. Humidity also affects the ties in that territory. Most of North China has light rainfall and most of this during the summertime. This condition probably does not affect the life of railway ties, although in such territory as the western end of the Peking-Suiyuan Ry., extending into the Mongolian territory, it is thought to increase the life rather than shorten it.

*Size and Treatment*—The usual dimensions for railway ties are 8 ft. x 9 x 6 in. Bridge ties, as a rule, are 10 ft. x 9 x 8 in. There are very few creosoted ties in use in China. The Chinese Government railways, such as Peking-Hankow Ry., Tientsin-Pukow Ry., and others treat their ties in their own creosote plants. Treated ties will probably be used in the future as they become better known.

Tenders are usually called for by the railways concerned and terms of payment arranged by the railway. Payment is probably the most difficult factor at present, as the Chinese railways will give the business to whomsoever will give them the longest credit almost regardless of price. Americans may deal directly with the several railway purchasing departments but much of this business is handled through commission houses. American species are included in official and semiofficial invitations for tenders.

## Handling Ethics Cases in Iowa

Following a recommendation of the ethics committee of the Iowa Engineering Society, special committees, usually of local members, are appointed to investigate breaches of the code. In recommending the abolition of a standing committee on ethics the report indicates that engineering organizations with one or two exceptions do not have such a standing committee. The committee also found that members in a position to know something of a case in question are reluctant to furnish the facts and put them in writing. Four cases were reported, but without the co-operation of members so that evidence could be produced necessary to prefer formal charges, the committee could not function. In compliance with the above suggested procedure, one special committee has already been authorized by the executive committee. For work somewhat along the line of ethics is a special committee appointed by the executive committee to investigate cases where bids are received for the position of county engineer when the sole consideration is one of salary.

# Engineering Schools Fall Short of Modern Needs

## Narrow Training Fails to Meet Cultural and Economic Demands—Suggests Longer Course for Engineering Degree

By John H. Dunlap

Former Professor of Hydraulics and Sanitary Engineering
University of Iowa

*Since the preparation of the following paper (presented to the Society for the Promotion of Engineering Education, Urbana, Ill., June 21, 1922) Professor Dunlap has been elected to be Secretary of the American Society of Civil Engineers. Special interest attaches, therefore, to his views as to the problems of the profession and the ability of the engineering schools to prepare men to cope with them*—Editor.

In view of the enlarged service that our profession is now asked to render, a heavier responsibility than ever before now rests upon the institutions entrusted with the task of preparing the engineer for his life work. Engineering colleges, sensing this responsibility, should determine to maintain their leadership of a generation ago, to the end that ours may be the best prepared of all the professions. But, due in large measure to our failure to understand the imperative needs of a new day, we have allowed our engineering colleges to lose their former leadership. At our annual meeting at Ann Arbor two years ago I called your attention to the following disheartening statistics. (See *Proceedings S. P. E. E.*, Vol. 28, 1921, pp. 128-136.) In the school year of 1898-99 only 14 per cent of the medical schools required for admission more than a one-year high school course, as compared with 33 per cent of the law schools, and 80 per cent of the engineering schools. Moreover, 91 per cent of the medical schools had a four-year course, with an average of 28 months in attendance, as compared with 98 per cent of the engineering schools, with an average of 35 months in attendence. The law school course was much briefer than that of either of the others. Accordingly, twenty years ago, the requirements for admission to engineering schools, as well as the length of course, greatly exceeded those of law and medical schools.

The same test applied now shows results decidedly unfavorable to the engineering schools. The medical schools, twenty years ago at the bottom, are now at the top; while the engineering schools, twenty years ago at the top, are now at the bottom, with the law schools in a middle position. The leading dental colleges began to require in 1921 one year of liberal arts college credit for entrance to the four-year dental course. The graduation requirements of the leading schools of theology now consist of a four-year liberal arts course plus a three-year theological course. Accordingly, engineering colleges requiring four years of study in addition to a four-year high school course are now fifth on the list of professional colleges. Indeed it is very doubtful whether they should be classed as professional colleges at all. You will recall that at the annual meeting at New Haven last year, Prof. W. H. Burr declared the present curricula in our engineering colleges to be behind the times.

*Specifications for the Engineer*—To write specifications for the engineer is not easy. In *Engineering Education* for May, 1922, pp. 403-406, Prof. Frank H. Neff suggests the following list of desirable qualities: kindliness, modesty, energy, patience, perseverance, honesty, a trained mind, thoroughness, accuracy, capacity for details, and breadth of judgment. This list, however, fits equally well any educated man.

In an editorial in *Engineering News*, May 11, 1893, p. 445, "The Ideal Engineering School," Arthur M. Wellington set forth a list of six acquirements to be expected of an engineering student upon graduation: 1. A good common school or high school education; 2. Ability to look oneself in the face and not be ashamed; 3. Practical gumption, physical vigor, mental calmness and keenness; 4. Ability to appear always at one's best; 5. A book knowledge of engineering; 6. Some practical knowledge of engineering. Four of these six acquirements apply equally well to anyone, while only the last two apply peculiarly to the engineer.

In 1918, Charles R. Mann reported in Bulletin No. 11, Carnegie Foundation for the Advancement of Teaching, "A Study of Engineering Education" that he sent to the 30,000 members of the four founder engineering societies a list of six groups of qualities headed by character, judgment, efficiency, understanding of men, knowledge, and technique. He requested that the list be returned with these six qualities numbered in the order of their importance in determining engineering success. In the seven thousand replies which were received, the character group was voted almost unanimously a place at the head of the list while technique was at the bottom of the list. While we all agree as to the importance of character, we all know that without a mastery of technique, an engineer is a failure. Such a discussion is fruitless. Furthermore, to tell an engineering college that character is important without indicating the educational process by which the college may develop character, is not of great assistance.

*Ten Essentials*—In that which follows an attempt is made to specify the sources from which character springs, in so far as the engineering college is concerned. I believe that no one of the accomplishments to be specified can be omitted from the preparation of the engineer without failure resulting. The first five specifications are general, and represent acquirements that every educated man should have. The last five are more technical, and represent the additional acquirements peculiarly necessary for the engineer.

1. Every educated man shall know his environment. To know one's environment in this era requires at least an understanding of the principal facts of history, biology, geology, and astronomy; mathematics, physics and chemistry; sociology, political science and economics. It would be impossible for everyone to cover the details of these subjects as they are now presented in most of our curricula. Readjustment of our present water-tight compartment system of departmental organization would have to be made.

2. Every educated man shall know himself. Self, as here used, has the broad meaning which includes not only the individual ego, but also those things and people that act and react upon the individual. For a man to know himself, he must know those great storehouses of human thought and aspiration, literature, music and art. He must know the principal facts of philosophy and of psychology. The task today of knowing self is far more difficult than in the days when to "know thyself" became the ideal of the young Greek. And yet many of our graduates do not attain even the standard of the Greek, to say nothing of that early Hebrew discovery in psychology: "The fear of the Lord, that is wisdom; and to depart from evil is understanding." Illustrations of the failure of modern education in these respects are all too easy to find. For example, I have had an experience with a graduate student which has made me very thoughtful concerning a system of education which permits a man to become a graduate student, who is still a child so far as his knowledge of himself and of his environment is concerned.

3. Every educated man shall think well.

4. Every educated man shall write well.

5. Every educated man shall speak well. It would seem that these last three specifications were so axiomatic that our educational process would insist upon them. If one really wishes to know, however, how little attention is paid to these accomplishments in our engineering courses, he should serve as secretary of a good-sized engineering society. Such an experience would lead inevitably to the conclusion that a pitiably small percentage of engineers can think well, write well, or speak well.

6. Every engineer shall know the sources of scientific information. He should be at home in libraries, and be able to determine what has been written upon any subject in which he may be interested. In this connection I invite

your attention to an article in *Engineering Education* for May, 1922, pp. 407-420, by E. H. McClelland, technology librarian, Carnegie Library of Pittsburgh, entitled "Instruction of Students in the Use of Technical Literature; an Unexploited Phase of Engineering Education." Your attention is invited also to the excellent course of this character at the University of Illinois for the students in chemical engineering.

7. Every engineer shall be skilled in using the method of applied science to solve engineering problems. He must, of course, first master the fundamental principles of applied science so far as they are tools of the engineer. Right here the line is most sharply drawn between the engineer and the physicist, between the applied scientist and the scientist. The physicist needs only to know the fundamental principles of science, while the engineer must not only know them, but also know how to apply them.

8. Every engineer shall be thoroughly trained in costs and values. One definition of an engineer is that he can do for one dollar what anyone can for two. In almost all engineering work the final control of design and construction is cost. Despite the controlling importance of costs and values, very little of scientific worth concerning them is to be found in our textbooks, or magazines. Even *Engineering News-Record*, for example, still reports bids received in such a way as to be of little use to the engineer. Take this case in the issue of June 8. "Maple Heights, Ohio—For 14,735 ft. 4-10 in. mains in Dunham, Rockside, Kohout, Raymond and Royal Sts., from J. H. Dace, 1452 West 98th St., Cleveland, $40,816; W. McDowell & Son, 10319 Miles Ave., Cleveland, $45,514." From such a notice no knowledge whatever can be gained as to the price per foot for different diameters of main, or as to the depths and the conditions under which the pipe was to be laid. A few days ago I was talking about engineering education with the head of the leading firm of structural engineers in Iowa. His comments on the lack of attention to costs in our engineering colleges were emphatic, to say the least.

9. Every engineer shall prove himself to be an economic asset in his work, and shall understand the commercial and ethical aspects of professional practice. Throughout his entire college course he should be taught to look upon himself as one who by his peculiar skill can save his employer much useless expenditure, whether his employer be a private individual, or a group of individuals like a county board of supervisors, a city council, or the public in general. Many of the counties in Iowa are so little convinced that an engineer is an economic asset to them, that they do not hesitate to advertise for bids for engineering services, and to accept the lowest bid. Only a few weeks ago such a case occurred in one of the counties. The secretary of the Iowa Engineering Society, learning at the last minute what was planned, sent the county auditor a letter which arrived at the moment the bids were being opened. Therefore, the letter was opened and read along with the bids. Part of it read as follows: "Your county engineer is a vital factor in the conduct of the affairs of your county, and upon him depends a great deal how much money is saved to your county in carrying out the road program. It is considered unethical among the best class of engineers to submit bids on the basis of salary, and for this reason your county, more than likely, will not get the best engineering services. The best engineer you can get should save your county more than his salary in any year. If he cannot, he has very little excuse for existing. With these facts in mind you will see that it is to your interest to employ your engineer on the basis of his fitness for the position." Strange to say, the board of supervisors was so impressed by this letter that they rejected all bids and re-employed their former county engineer. This situation would never have developed if this county engineer had been taught, in his college days, to look upon himself as an economic asset to his employer, and if he had been taught the necessity of proving it to his employer from time to time. Anyone who does not enjoy cost data, whether applied to construction work or to his own job, probably is out of place in the engineering profession.

10. Every engineer shall be taught throughout his college course that one of his chief functions is to serve his community. Recently I asked Dr. Edward T. Devine, the sociologist, in what direction he considered the greatest hope of our municipalities to lie. He answered at once, in substance, in the application to community affairs of the abilities of technically trained men. In spite, however, of the manifest opportunities for service in our communities, composed as they are today principally of engineering units, our engineers do not occupy their rightful positions of leadership. At a dinner some time ago, I asked a woman who was a leader in the community affairs of her town, a small county-seat of less than four thousand population whether she was acquainted with the county engineer. Imagine my surprise to learn that she had not yet heard of him. As a sequel to this story, it should be added that a few weeks ago this county changed county engineers. Of course part of the trouble is that the training of the engineer is so narrow that he feels himself uncomfortable and embarresed when he attempts to help in public affairs. If the major part of the above specifications could be carried out, the engineer would find himself, as the years of practical experience came to him, the best prepared man in his community, and as a natural result, would assume leadership. While this has an important bearing on the relative standing of engineering as compared with other professions, it is even more important from the viewpoint of the community, and its need of men skilled in the method of applied science.

*Specifications Not Met*—The first five specifications, which are really essential to every man who calls himself educated, are for the most part ignored in our present engineering courses. Of the last five, which are intended to apply particularly to engineers, only one now receives careful attention; namely, the seventh, that every engineer shall be skilled in the knowledge and application of the fundamental principles of science. The other nine specifications may be met after graduation, and some engineers have found time to do this, but for the most part, the young graduate finds himself so busy for the first ten years furthering his knowledge of technique that he has little time for other study. Except for the successful few, therefore, some substantial progress in these ten objectives must be attained before graduation.

*The Time Required*—To cover the ground outlined, the course probably must be lengthened to five, and eventually to six years, although much time can be saved by certain modifications of the existing four-year course. So long ago as 1871, General Sylvanus Thayer, known as the father of the United States Military Academy, concluded that a six-year course was necessary and founded the Thayer School of Civil Engineering at Dartmouth. He stipulated that, after a college course of four years in Dartmouth College, a two-year advanced course in civil engineering should be given in the Thayer School. For twenty-two years this plan was followed, until in 1893 a five-year program was adopted, three years of which are given in Dartmouth and two in the Thayer School. Unfortunate experiments in lengthened curricula have been made at other institutions. At present the five-year course at the Thayer School and the six-year course at Columbia are the principal exceptions to the four-year plan. The recent conference at Chicago of the fourteen deans of Middle-West colleges leads us to hope that better days are dawning for engineering education.

But it would probably be unwise to require all the students who begin an engineering course to take the entire five or six years. A better plan would be a two-stage method, similar to that by which engineering is now taught in France and Italy. To quote from the report of the Committee on Technical Education of the Mining and Metallurgical Society of America; Bulletin No. 150, Vol. 14, Sept. 30, 1921, p. 175: "In France and Italy engineering is taught in two stages. The more advanced stage which aims to turn out actual engineers of training, ability, and power, is open only to those who have proved their right to enter it by conspicuous ability and fitness

in the first stage. And the first stage, though preparatory to the second, is so designed that the majority whose college career ends with it are not turned loose as two-spot engineers, yet ill-fitted by training and because of pride to do anything else. Instead, they are equipped to step into positions of intermediate responsibility, where they do high-grade work with entire self respect."

This suggests that the first four years of an engineering course be planned to fit men with no particular engineering ability to assume the subordinate positions in industry. The regular college degree of B. S. might be given at the conclusion of the four-year period. Then those who have shown themselves fit for advanced technical work in engineering should be encouraged to enter the fifth, or the fifth and sixth years of the complete course, from which they might be graduated with the professional degree of C. E.

*The Challenge*—We should not be alarmed at the suggestion to increase the length of course, in order to prepare the engineer more adequately. During the early history of the Rensselaer Polytechnic Institute, one year was sufficient. We have, therefore, already added three years to the course, and should expect to add more as science expands. The engineer has been making over the world until we are now in the midst of a mechanical age. Notwithstanding this, we have allowed the preparation of our engineers to lag behind the preparation for the other professions, and have actually lost the position of leadership occupied twenty years ago. Dean Mortimer E. Cooley, past-president of this society, recently expressed it in this way: "The engineer a generation ago was better prepared to do the work of his generation than is the engineer of today prepared to do the work of this generation."

We should insist that the engineer be the most carefully prepared man of our generation. He should know his environment and know himself; he should think well, write well, and speak well; he should be familiar with the sources of scientific information; he should know the fundamental principles of his calling and their application to the work of his profession; he should understand the controlling importance of costs and values and become an economic asset wherever he goes; and he should lead in every type of service that goes to upbuild not only his community, but his nation, and the world. Even as science and industry today are international, so should be the thinking of the engineer.

Let us as teachers do all in our power to prepare him to perform worthily his important part in the evolution of civilization.

## Motor Vehicle Loads in Massachusetts

During the past two years, and particularly in 1921, the Department of Public Works of Massachusetts has employed an investigator to ascertain what loads were being carried over the highways and to prosecute the law-breakers as he found them. The extent to which the state law limiting gross weights to 14 tons and weights per inch width of tire to 800 lb. has been ignored is remarkable, according to Arthur W. Dean, chief engineer, division of highways, in a recent address before the Boston Society of Civil Engineers. Trucks having a rated capacity of 5 tons and weighing approximately 5 tons were carrying loads weighing from 10 to 15 tons, so that the total load of truck and vehicle was approximately from 15 to 20 tons. With the worn-out tires on many of the trucks the load per inch width of tire was approximately from 1,000 to 1,500 lb. Statistics under preparation by the department show that this overloading is not confined to isolated cases, but is very frequent, and must be considered not only in connection with road surfaces and foundations but in connection with the designing of bridges.

# Earth-Filled Cofferdam With Concrete Core Wall

### Assembled On Trestle and Lowered by Chain Falls —Sheeting Cut to Contour of Bottom —Dry Dam Secured

UNUSUAL cofferdam construction in an inconvenient location was successfully accomplished in repairing an undermined, submerged wall-footing for the picker house of the Nashua Manufacturing Co., Nashua, N. H. The view, Fig. 1, shows the wall and cofferdam location. Scour produced by a swirl caused by the tailrace discharge meeting the opposite current of the river was the cause of the footing trouble. To disclose this trouble and to make repairs, the footing had to be laid dry and a cofferdam was designed as shown by Figs. 2 and 3.

Preliminary to the construction proper of the cofferdam, a stockpile of loam was assembled on the bank

FIG. 1. COFFERDAM LOCATION DIFFICULT OF ACCESS

in anticipation of frost and also so that the material would be at hand in quantity for quick use. A platform was also built in the stream, as indicated by the illustrations, and on it was assembled the cofferdam materials. From the platform, runways on trestle were built parallel to and on the two sides of the cofferdam wall location.

As indicated by Fig. 3 the dam varied in height from 6 to 12 ft. depending upon the depth of water. The width was 6 ft. from the outside to the inside sheathing, and was divided longitudinally into an outer section 12 in. wide and an inner section 5 ft. wide. The object of this division was to provide a place to pour a 12-in. section of concrete 2 ft. high for the whole length of the dam, about 70 ft. It was thought that this concrete might render it more difficult for the water to pass under the dam. This contingency was anticipated on account of the very uneven nature of the river bottom which was completely covered with boulders of various sizes. On top of this concrete, earth fill was to be placed, while the 5-ft. compartment was to be filled with puddled earth above the water line.

Upon completion of the runways the work of erecting the cofferdam proper was begun. At 8-ft. intervals,

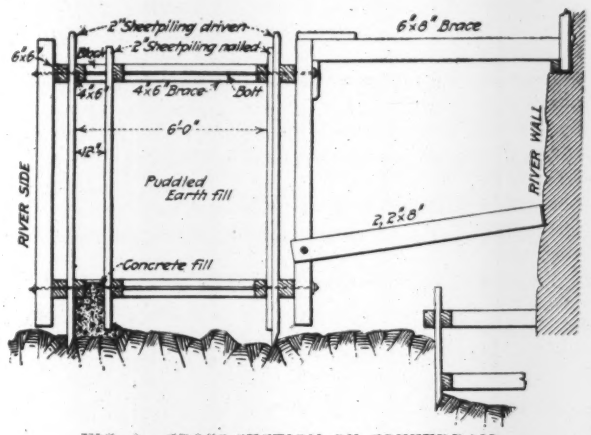



FIG. 2. CROSS-SECTION OF COFFERDAM

8 x 8-in. timbers were placed crosswise from one platform to the other. These were to serve as temporary beams to hold up the cofferdam during erection and were to be removed to allow the dam to be lowered into place.

Very careful soundings were now made over the site of the proposed dam, and profiles of the bottom were plotted. From these profiles it was computed just how many feet above the ultimate position the cofferdam would be built and the relative locations of the top and bottom rangers. It was decided to figure on a 6-ft. drop for the dam. At either end the lower rangers were sloped up so that this 6-ft. drop would not bring them in contact with boulders at any point where the water was shallow.

Before spiking on the sheathing, each piece was pushed down to the bottom and pulled up exactly 6 ft. where it was made fast. The result was that when the sheathing was in place, the bottom ends formed exact contours of the bottom directly under the three rows of sheathing. Consequently, when the dam was lowered, the sheathing conformed to the bottom; the dam maintained a vertical position, and very little driving was necessary before the sheathing started to penetrate, or, where rocks were encountered, refused to go any further.

As soon as the sheathing was in place, the braces and rangers on, and the whole thing assembled and bolted up in accordance with the detail, bents were erected over the dam, about every 10 ft. These bents rested on the platforms on either side. To the cross timbers, which were securely braced, 17 chain falls were attached and the hoisting chains were made fast to the cofferdam.

An even strain was put on the chain falls and the dam raised about 1 in. This permitted the removal of the 8-in. x 8-in. temporary bearers, after which the falls were gradually slacked off and the dam slowly lowered. Care was necessary at this juncture to guard against too much weight coming on one chain fall which might cause it to give way. To make sure that the dam would go down vertically and not be moved out of alignment by the current, 4 x 6-in. guides were put down inside of the rangers, extended to the bottom, and securely braced to the picker house. No weighting was necessary to take the cofferdam to the bottom. When the strain was off the falls, the dam was found resting solidly on the bottom, was standing vertical and in perfect alignment. A few sand bags were placed along the top rangers to guard against any movement and all the sheet piling which was intended to be driven was driven to refusal.

Two feet of concrete were now deposited in the outer 12-in. compartment and the remainder of this section and the 5-ft. section were subsequently filled with well puddled loam. The enclosed water next to the foundation wall was pumped out by means of a 6-in. centrifugal pump driven by an electric motor.

Upon examination, the foundation wall was found to be badly undermined. In the worst place the granite boulders were undermined about 8 ft. This undermining extended the whole length of that part of the building which bordered on the river, approximately 70 ft. A line of sheet piling was driven about 4 ft. outside the face of the old granite foundations. Inside of this at intervals along the walls, short sections were excavated to the required depths and extending from the sheet piling as far and under the wall as the latter had been undermined. Concrete was poured into these sections and carried up to form suitable bearings for the old footing. After this concrete had set up sufficiently to carry a load, the remaining intervals along the wall were similarly treated so as to form a con-

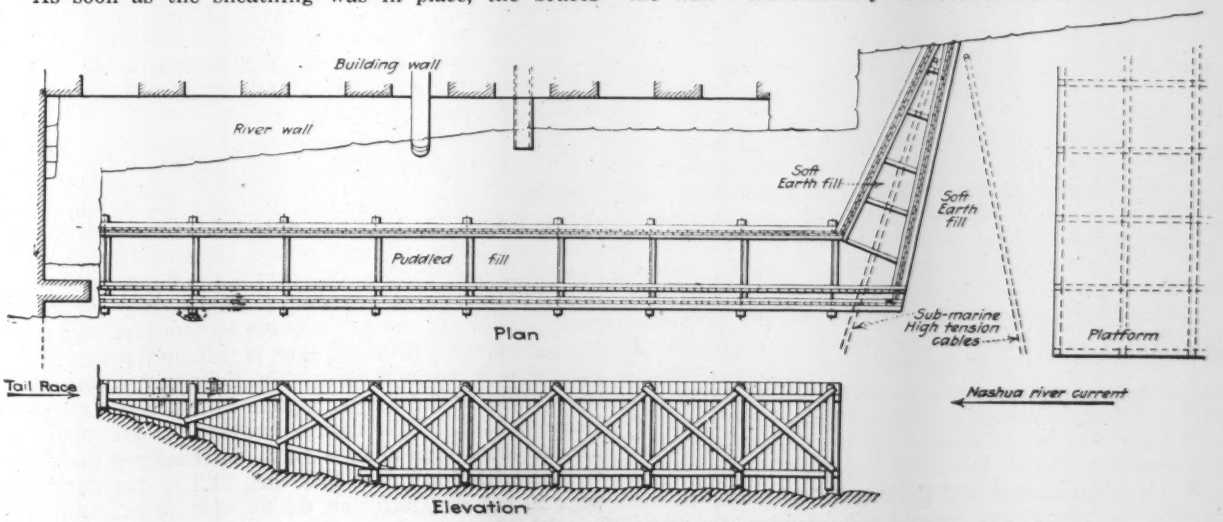



FIG. 3. PLAN AND ELEVATION OF COFFERDAM

tinuous spread footing under the old granite foundations.

Forms were set up and the old stone foundation was faced up on a batter with the concrete wall, the minimum thickness of which at top was about 2 ft. An 8-in. reinforced-concrete slab was carried from the top of this wall over the upper surface of the old projecting foundation and terminated at the brick wall of the picker room. A concrete slab was poured along the bottom of the new concrete facing wall, was carried out to the sheet piling and extended the whole length of that part of the wall which had been repaired. Finally, it was decided to leave the cofferdam in place, as an additional protection to the footing against the abrasion of the rapid curent.

The repair work described was carried on by the Osgood Construction Co., Nashua, N. H., under the supervision of B. J. Craggy, master mechanic for the Nashua Manufacturing Co. Operations were started about Nov. 4, and completed about Dec. 31, 1921.

## Generating Station Has Automatic Switching and Control

### Dial Telephone Device Gives Head of Water and Gate Opening, Starts and Stops Machines, Warns of Danger, Etc., Over 3-Mile Line

EQUIPMENT for the automatic control of a hydroelectric generating station has been developed by engineers of the Westinghouse Electric and Manufacturing Co. and the first installation will be made on the system of the Northeastern Power Co., of Wisconsin. The equipment is included in a contract recently entered into by the electric company to install automatic switching apparatus at the generating station of the Johnson Falls development, about 60 miles north of Green Bay, Wis. The station will consist of two 2,200-kva. waterwheel generators and will be operated over a telephone circuit from the High Falls plant, three miles away.

At the latter station will be installed a dial of the type usually found in automatic telephone systems with a telephone receiver, reversing line key and a loud-speaking receiver for alarm purposes. At the automatic generating station will be installed a 16-volt storage battery together with a group of selectors for performing the various operations and setting up the necessary signals for answers. The connection between these two will consist of a single pair of copper-clad steel wires.

*Head Ascertained*—If the operator wishes to ascertain the head of water at the generating station he will dial the proper code number and if he has dialed correctly that number will be repeated at the generating station by bell strokes. After the bell signal the operator hears a series of buzzer notes which he counts —the largest number being ten. The total probable variation in the water level is divided into ten divisions, each buzzer tone representing one division. Thus, if the water were at half the normal head the operator would count five buzzer tones and then, by adding the base height of the water to five times the amount of each step, the actual height of the water would be indicated.

*Starting Generators*—If the amount of water in the forebay is sufficient to operate one machine, the operator clears the line and dials the number required to operate either generator. That number (if the signal is correctly given) will be repeated at the generating station by bell strokes. If the operator in any of these operations signals incorrectly his mistake is revealed by the number of bell strokes given. If, however, the correct number of strokes is counted the line key is left in the closed position for a few seconds and the generator will be started and thrown on the line. If it is desired to stop either machine two other code numbers are provided.

*Varying the Load*—The automatic control is designed to start the machine and put it on a full-gate opening. If the operator decides that the load cannot be carried by the amount of water available he can reduce the load by dialing the proper number, after which the pilot motor on the governor will be operated for a few seconds. Immediately after the short period during which the governor motor operates to reduce the load, the selector is connected to a code signal device which gives the position of the gate in the waterwheel by means of a series of buzzer tones in the same manner in which the head of water is indicated, each buzzer tone representing one-tenth of the total gate opening. If the load is reduced too much another number for increasing the load on the desired machine is dialed. Another pair of numbers is provided simply to read the gate opening on either of the generators without changing the load.

*Alarm Signals*—When anything happens in the generating station of an unusual character (if, for instance, the machine shuts down on overload or locks out for any reason) a high-pitched warning tone is put onto the telephone line and sounds to the operator from the loud-speaking receiver. To stop the operation of this signal another number is provided. If, after the warning signal has been given, it is desired to locate the exact seat of the trouble another number will connect in the circuit with a slow-motion selector which will test each piece of apparatus in succession on the two generators. The operator keeps track of the number of operations and is able to recognize the condition of each piece of apparatus by the tone of the signal. A low-pitched buzzer signal will indicate normal operation, while a very shrill, high-pitched tone will indicate trouble. By counting the number of indications, the particular step which gives the abnormal signal can be ascertained and then, by consulting the reference list, the piece of apparatus giving trouble can be identified. Instructions to the maintenance man can therefore be explicitly given.

### Hydrated Lime in Concrete

In the report of the discussion by T. B. Shertzer (Lime Association) of the Abrams' tests on hydrated lime in concrete, it was stated (*Engineering News-Record*, July 6, 1922, p. 30) that if the mixtures in the Abrams' tests were adjusted so as to study those of proper water content the average compressive strength of concrete with hydrated lime is 9 lb. per square inch greater than without lime. Mr. Schertzer states that this should be 9.6 lb. per square inch *per per cent of included lime*. This figure, however, is an average. The actual figures show a 14 lb. increase per per cent of lime with 5 per cent inclusion, 11.3 lb. per per cent with 10 per cent inclusion, 6.8 lb. with 20 per cent, 5.1 lb. with 33 per cent and 4.9 with 50 per cent.

# Building Reinforced-Concrete Boardwalk at Coney Island

## City Putting in 9,500-Ft. Walk and Extending Bathing Beach by 1,700,000-Yd. Sand Fill—Groins and Bulkheads to Prevent Scour—Pleasure-Seeking Crowds Impede Progress

DELIVERY of materials and the actual prosecution of the work has become somewhat of a problem in constructing the reinforced-concrete boardwalk and shore-protection works at Coney Island, N. Y. As the work was started early in the spring it has reached the height of its activity during the busiest part of the season at Coney Island. Consequently, the beach along which the work is being done is swarmed with people on hot days and delivery of materials and prosecution of the work has at times become well-nigh impossible. Also, as the hydraulic fill has not yet been placed the presence of the piles along the bathing beach has become a menace, particularly during heavy seas, which bathers refuse to recognize.

*Description of Boardwalk*—The boardwalk itself extends from the foot of Ocean Parkway to the entrance of Sea Gate at West 37th Street, the entire length of the city-owned beach, or a distance of 9,500 ft. The walk will be 80 ft. wide or 20 ft. wider than the widest part of the Atlantic City boardwalk. The floor surface will be 13 ft. above normal high tide and will be reached from adjacent streets by double ramps at each intersection. The height of the walk was fixed to give ample clear space under the boardwalk, both longitudinally and laterally. The walk itself is made up of a series of pile bents spaced about 20 ft. apart. Each bent is composed of two groups of four reinforced-concrete piles each group supporting a reinforced-concrete girder. These girders cantilever out beyond the end piles of each group, as shown in the drawings and views, thus leaving a longitudinal expansion joint down the middle of the structure. The piles are 14 in. square and 28 ft. long and are spaced 10 ft. on centers. Each pile will have a penetration in the sand of at least 20 ft. when the sand fill is in place.

The boardwalk itself is designed to carry a live-load of 125 lb. per sq.ft., considered the maximum which could be imposed even with the heaviest pedestrian traffic. A test load was made on one bent early in the construction of the boardwalk. A load approximating 200 lb. per sq.ft. was placed on the bent and the maximum subsidence was less than one inch.

The superstructure of the boardwalk is to be of yellow pine timber. The floor beams will be 4 by 14 in. and spaced 2 ft. apart. They will run longitudinally and are to be creosoted. The flooring will be of dressed Douglas fir and the joints between boards will be but ¼ in. This will add to the durability of the structure by preventing the splintering of individual boards. The boards will be laid in a diagonal direction to facilitate ease in walking. Provision has also been made for two longitudinal strips each 6 ft. wide of closely-laid planks which can be used for rolling chairs in case they are found to be popular and practicable.

*Piles and Girders*—Borings made in the vicinity of Coney Island indicate that the sand extends to a great depth, in some places 80 ft. The piles, therefore, are easily jetted into place within an inch or two of exact grade and then lightly tapped by a piledriver hammer set in the swinging leads of the derrick which is usually used to handle the piles. The boardwalk is built in its two longitudinal sections, bents of four piles each being set by one derrick and the other half section being set by the second derrick.

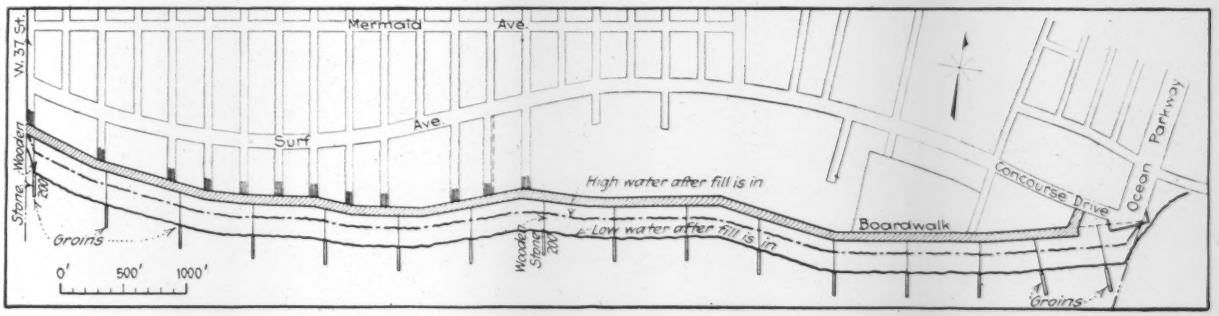



FIG. 1—POSITION OF MUNICIPAL BOARDWALK ALONG CONEY ISLAND BEACH

Inshore side of the boardwalk is the northern boundary of the city-owned property. The line of both high and low water, after the 1,700,000-yd. fill is placed, is shown, indicating how greatly the bathing facilities are to be extended.

Girders are 39 ft. 5½ in. long, 10 in. wide and 22 in. deep. When poured the formwork is supported on temporary timber beams placed on either side of the piles and bolted together on both sides of each pile. Pouring is done in a direction opposite to that of setting the piles, making it possible to pour all girders without transporting materials, equipment or formwork over those poured until the side forms at least have been stripped. Side forms are usually stripped after three or four days, but bottom forms are left in place at least 15 days. Concrete is mixed on shore and transported in buggies on a staging built over the forms.

The concrete piles are pre-cast in the construction company's Flushing, N. Y., yard, being barged to Coney Island Creek and hauled by motor trucks to the site. Inasmuch as it has not always been possible for the city to secure access to the site of the boardwalk at the most convenient locations, it has been necessary to transport single piles by tractor through the sand a maximum distance of 1,500 ft. This condition has slowed up the work to some extent.

*Rich Concrete Mix Specified*—Insurance against deterioration from sea water is embodied in the specifications for the concrete both in piles and girders. A 1:1½:3 mixture and traprock of an outside size of 1 in., are specified. Reinforcing steel both in piles and girders is

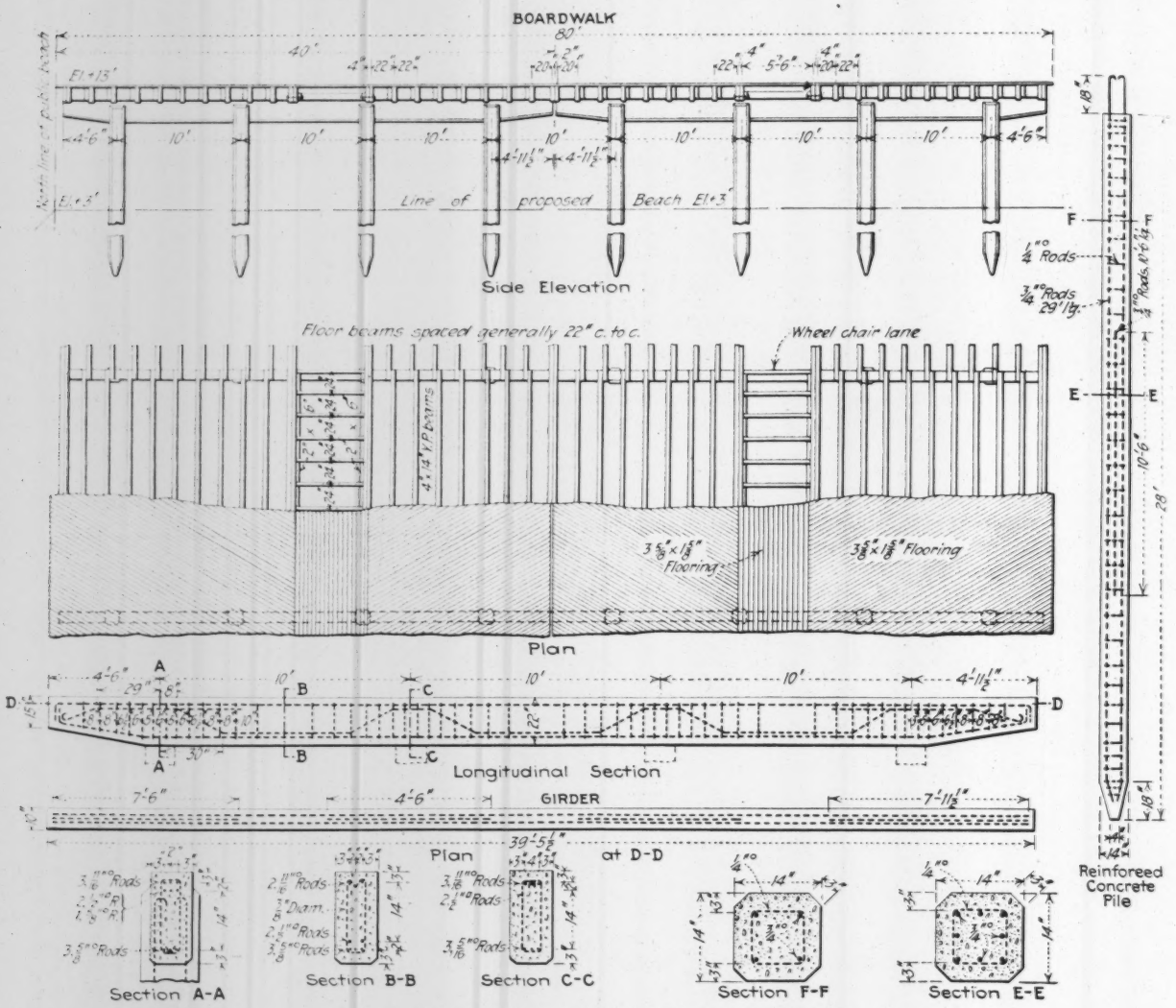



FIG. 3—BOARDWALK, GIRDER AND PILE DETAILS

embedded 3 in. in the concrete. After some of the piles had been placed hairline cracks were discovered on a few. Each pile in place was therefore carefully inspected and the hairline cracks chiseled out to discover if there was a possibility of them extending into the steel. So far there is no indication that the steel is in danger of being exposed either on piles or girders. Wherever there is the slightest indication of the concrete spalling off or cracking, piles and girders will be thoroughly waterproofed. All piles and girders are to have a finish coat of cement.

*Shore-Protection Works*—The shore-protection works consist of a series of groins extending from approximately the inshore side of the boardwalk out a distance of about 300 ft. These groins are spaced at approximately 600 ft. c. to c. and bear generally in a southeast direction though the position of each is such as to afford the greatest resistance to wave attack, affording at the same time the maximum protection to the existing beach and the additional beach which will be thrown up by the hydraulic fill. Out to the new low-water line these groins are made of timber piles and a double row of lapped sheetpiling with wales bolted to and through the piles. All of the timber used is creosoted. Penetration of the piles in the groins is specified at 17 ft. Sheetpiling must be driven 10 ft. These are minimum depths below the present sand level and are required to prevent possible damage from excessive scour.

The outer ends of the groins extending seaward about 200 ft. are composed of a mass of heavy stones. The upper surface of the rock section is 2 ft. above high tide and has a top width of 10 ft. It is designed to have slopes of 45 deg., making at the extreme outer end, where the water has an average depth of 14 ft. below high water, a base width of 50 ft. Stone varying from 100 lb. up to 7 and 10 tons is used in these rock sections. The smaller stones are being used to fill the voids between the large ones while those of greater weight are intended to surround and cap the interior core, offering the greatest resistance to wave action. Stone is brought mainly from granite quarries in Massachusetts and landed at Gravesend Bay. From there it is transferred to barges which are equipped with calibrated wells for measuring the tonnage. The difference in the draft of the vessel when filled and empty therefore bears a direct relation to the stone tonnage.

In order to protect the shore end of the groins from scour which might occur during heavy storms or excep-

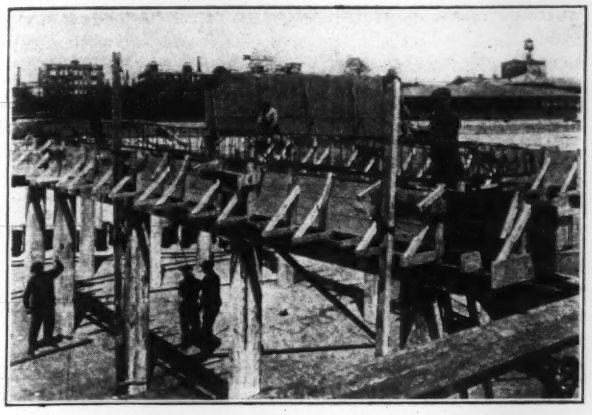


FIG. 2—SETTING A GIRDER REINFORCING CRADLE

tionally high tides, bulkheads of creosoted timber piles and splined sheeting parallel the interior line of the improvement wherever the wave action has demonstrated this to be necessary.

Sheetpiling and wales for the groins are handled by a floatable derrick, floats being made of specially-constructed steel tanks. A patented walking derrick of British design was first used but found impracticable because of the inability to move it at will except in a true forward direction.

*Sand Fill*—When these shore-protection structures are completed, the contractor is to deposit 1,700,000 cu.yd. of sand fill on the ocean floor between and beyond the exterior rock ends of the groins in such a manner as to produce a new or extended beach approximating in slope the present beach and ocean bed. The effect of this is to advance the high- and low-water mark seaward a distance of about 250 ft., thereby providing a bathing area in front of the boardwalk. Sand for this fill is to be taken from the ocean bed outside the limits of the city-owned property which extends 1,500 ft. out from the approximate present high-water mark. Placing this fill will probably afford the feature of the job. Just what success the contractor will have in placing a hydraulic fill on the shore without any bulkhead protection as yet remains uncertain. As it appears, the job will not be the simple one of depositing sand behind a bulkhead. Beside the possibility of the sand not being retained as placed, the contractor will be exposed, in dredging, to the dangers of an open sea.

FIG. 4—GIRDERS READY FOR FLOOR-BEAMS
Piles are darkened by a green marine growth. This part of the boardwalk is near the upper, or Ocean Parkway, end.

*Miscellaneous Installations*—Along the ocean front on the shore side provision has been made for a galvanized-pipe guard-rail fence and wherever necessary a similar fence will be placed on the north side of the walk. Steps will lead to the beach at intervals and as many as are needed can be added as required. Lamp standards for lighting the walk are to be placed at frequent intervals along the outer side of the walk and at the foot of all streets. In the pending contract no provision is made for shelter houses or resting places.

The Coney Island Boardwalk was planned and designed by Philip P. Farley, consulting engineer of the Borough of Brooklyn. It is being constructed under his special direction through the Bureau of Highways of which J. S. Schmitt is chief engineer. Arthur C. Forbes is the resident engineer and W. H. MacMahon represents the consulting engineer on the work. The Phoenix Construction Co., of New York, has the general contract for the beach improvement. John A. Benham is the general superintendent and P. W. Hughes superintendent on the work.

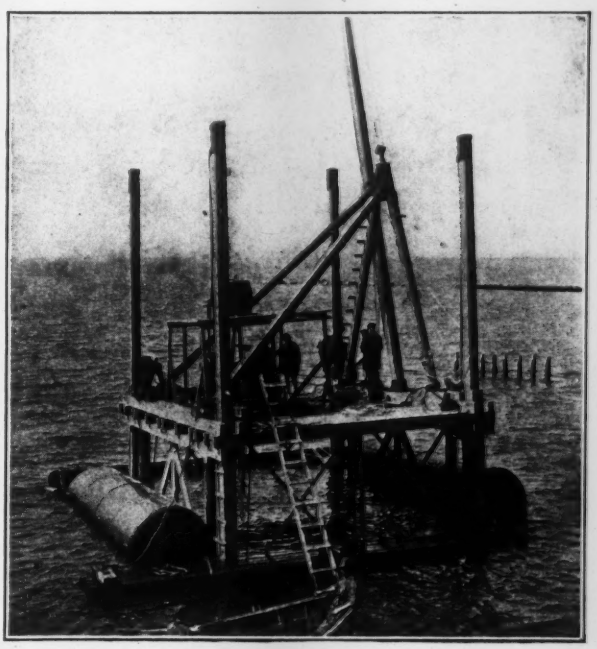


FIG. 5—FLOATABLE DERRICK FOR BUILDING GROINS

## Improved Grain Elevators at Dunkirk, France

A recent bulletin by the French Chamber of Commerce repots the installation of specially designed grain elevators at Dunkirk and the resulting improvement in unloading facilities at that port. The new elevators are capable of discharging grain from vessels into sacks at the rate of 2,000 tons per day, with a great reduction in wastage from the former methods. During the war Dunkirk was used as a supply base for the Allied armies operating in northern France. Plans are now being made for improvement of the port on a large scale.—*Commerce Reports.*

# *Notes from the Inter-Mountain Country*

By W. W. DeBerard
Western Editor, *Engineering News-Record*

## The Southeast Corner of Wyoming

"WHY stop at Cheyenne? What is so interesting there to engineers?" said the chief when I was making up my schedule of a trip to the West. Letters from good friends in the southeast corner of this rapidly developing frontier state with its newly found oil resources and irrigated farm projects indicated to me that there must be quite enough doing from the engineers' viewpoint. Furthermore J. A. Whiting had

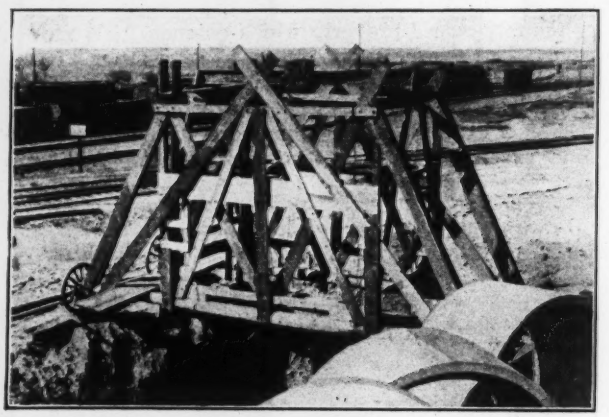
LAYING 54-IN. REINFORCED-CONCRETE SEWER PIPE IN MAIN STREET OF CHEYENNE
Gasoline excavator also lays pipe and is followed closely by gasoline backfiller.

long ago written me about a half-million dollar sewer job and his experience at the water-works filtration plant and dam from frost on porous concrete. I knew also that there was a large road-building program and had had much correspondence with Z. E. Sevison, state highway engineer, concerning the 2,400 ft. of precast concrete slabs on the Caspar-Salt Creek highway. I knew from previous experience that Cheyenne had no hard street pavements but utilized disintegrated granite which makes an ideal surface. What I did not know was the fact that the Wind River Canyon road was about to be started, opening up a rich territory 100 x 150 miles in extent; nor did I realize that the Lincoln Highway had been relocated over famous Sherman Hill. These projects proved to be entirely sufficient to occupy most fully the short day it was possible to crowd into my schedule.

Cheyenne pays tribute to high freight rates and every citizen reminds you of that fact as a reason for the extra tariff you pay for a comparatively small article, to which 10 to 30 per cent additional has been added although the freight could not possibly be more than a few cents per dozen articles. Rents are high due to the freight on lumber and supplies. This reminds me that three years ago on the occasion of a former visit when daylight saving time had recently been inaugurated, two engineers were building a house to sell, utilizing their after-hours time to piece out a meager salary. I was interested in that house and on inquiry found that one of the engineers, now holding down a much more substantial position, was living in it and had been saving rent for the last three years. In common with almost every other western city, Cheyenne has been continuously in need of houses for several years. With the present building boom the supply is soon likely to catch up with the demand. Housing developments had their effect in pushing the sewer work to the construction stage.

Waiting for the conventional calling hour of 9 o'clock to arrive, I concluded to look over the sewer job and make notes by the photograph method. Everywhere in the downtown district it was evident that the contractor had not yet placed all of his numerous 54-in. reinforced-concrete pipe underground. Though not new, the pipe-lowering arrangement interested me greatly and after several attempts I secured a view that seemed worth while to pass on to my friends. But I am including also a view of the main street showing the use of a gas-engine excavator in handling the work so as to keep open the trenches a minimum length of time. The whole job was said to be too large for the local contractor with limited credit and he has delayed the work far beyond the patience of many of the citizens of the town. Furthermore, costs on the easiest sections done first have been fairly near to the bid price. Future unit costs are almost sure to exceed the bid price and prove disastrous to the contractor. In consequence, Cheyenne faces the almost certainty of having to take over the work and finish it by force account or through a new contractor. Low bids too often end this way, to the embarrassment of the contractor and the almost certain unpleasantness to the engineers in charge.

Waterproofing seeping concrete on both the dam and the filtration plant walls has stopped the crumbling on the outside of the concrete effectively proving, according to J. A. Whiting, the contention that the action was not

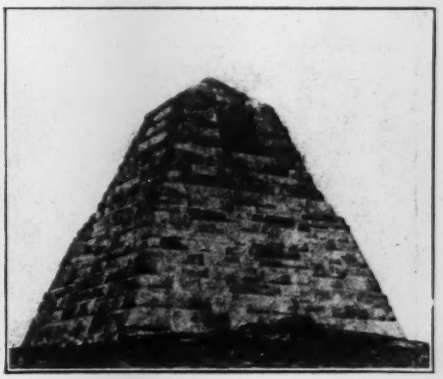


MOUNTED PIPE-LAYING FRAME FOR LARGE SIZES
A hand-operated block and fall lifts pipe off of the supporting skid planks and lowers it into place.

due to alkali but to frost. (See *Engineering News-Record*, p. 947, June 2, 1921).

*Road Construction*—Large expenditures of money for roads in Wyoming have reached the peak for the time being at least. Valuations are low, population is scanty and the mileage is great. As through-route traffic has been insistent on getting a few roads through the state in operating shape, work has been concentrated on these routes and several will be completed this season.

Here, as elsewhere in the mountain country, political maps are occasionally put out with wide broad bands in red showing the unsuspecting tourist where he can drive. These maps occasionally show roads that not even a burro could negotiate. The ulterior motive behind the publication of such maps is two-fold. The politician hopes to enlist support for the local project and the merchant along the route expects to sell supplies. It is a poor practice. Selection of routes causes much wrangling between the Bureau of Public Roads, local influential chambers of commerce and business men who ought to be decidedly ashamed of themselves. The main highways of the country are being built so that the traveling public may reach its destination in the shortest time and most economical way; not to enrich



SHERMAN HILL SCENERY FROM THE LINCOLN HIGHWAY AND THE AMES BROTHERS MONUMENT

Typical of the topography where the engineers sought a route on ridges free from wind-blown snow. The monument to the promoters of the Union Pacific Ry is the only record of the abandoned town site on Sherman Hill.

a few grocery stores. State highway officials are alive to this situation and in the majority of cases stand with the federal officials for the best location. This question of locations is one of the uppermost problems in the frontier state road development, because many of them are only now emerging from the trail stage to the road stage, the road surfacing stage being still years ahead.

Precast concrete slab roads have proved their worth in Wyoming in the opinion of the state officials and some of the federal engineers. Dr. Hewes of the San Francisco office, Bureau of Public Roads, and A. B. Fletcher, chief engineer of the State Highway Department of California, were so impressed with the utility of the method for certain isolated locations that the latter who had been over the road the day before my arrival in Cheyenne, may lay some of the slab road in California. However, the slabs proposed will be 3 x 10 ft. By laying six slabs side by side on an 18-ft. road the traffic will straddle the longitudinal joints. Practically all of the numerous kinds of joints on the experimental road have proved satisfactory but the plain joint laid at a slight angle with the transverse line seems best, inasmuch as it permits the slabs to be removed easily and to a certain extent it prevents displacement of the slab. The present experience indicates a probable cost per square yard of somewhere near $3. The use of Haydite, the cellular burned clay aggregate used in ship construction, is being looked into seriously because a reduction in weight from 150 to 100 lb. per cubic foot will be no small item when slabs must be hauled 30 to 40 miles. Later inquiry from the company at Kansas City elicited the information that while no official tests on abrasion of Haydite concrete has been made, nevertheless a few unofficial tests made at the University of Kansas indicate that the reduction due to abrasion in a rattler is comparable with many of the accepted limestone aggregates. Practical consideration is given to this light-weight aggregate since it is likely one of the largest oil companies at Casper will install a plant for its manufacture for its own use. Concrete made from Haydite has been particularly successful as a light cover for oil tanks and for floors in some of the older tanks which have begun to deteriorate.

The Wind River Canyon road interested me not only from the heavy construction standpoint in the box canyon as portrayed in the numerous photographs which C. C. Warrington, deputy state highway engineer, and R. L. Silver, district engineer in charge, enthusiastically exhibited, but because it was one of the few highways in the country which are being built to open up a new country shut in by the mountains. The area is practically inaccessible from the outside because of the difficult grades over the high mountain passes and is cut off absolutely for five or six months of the year by snow blockades. On the 13½ miles in the contract recently let to the Utah Construction Co., 11½ miles must be carved out of the solid rock, making 94 per cent of the excavation rock (284,000 cu.yd.). Incidentally, this road will be the main route to Yellowstone Park. Contractors will be interested to know that the solid rock excavation went at 68½c. per cubic yard, a decidedly low figure under the circumstances.

In the bridge department of the highway department a brief interview with J. S. Seiler, bridge engineer, indicated that novel and economical designs are being worked out in U-shaped abutments and cantilever concrete bridges with inverted T-beams. Altogether one gets the impression that decidedly high grade work is being turned out in Wyoming and that somewhere at the top proper confidence is reposed in the engineering staff, together with the necessary support to put the plans into execution.

Unfortunately F. C. Emerson, state engineer, whose sane views on the utilization of the water storage in Yellowstone Park were given in *Engineering News-Record*, p. 777, May 5, 1921, was out of the city. Mr. Emerson could have told me what Montana citizens thought of the Colorado River controversy, and could have checked up such layman opinions as had been expressed to the effect that

Wyoming would be against the legislation favoring the lower Colorado River developments which many people felt would benefit the states organized to take advantage of it. Wyoming is not so organized nor so situated as to benefit.

*Along the New Highway* — Confronted with the choice as to whether I should take a 50-mile trip to see a newly constructed concrete sheep-dipping tank which Senator Warren was having installed on his sheep range or to go 60 miles over Sherman Hill, via the Lincoln Highway to Laramie was a problem until I got the invitation-givers to get together and combine the trips so as to take in both of them. Sherman Hill as a station is no more. Buford is now at the summit. The huge monument to Oakes and Oliver Ames of Boston, the financial backers of the Union Pacific, erected near the

J. A. WHITING, JUNIOR AND SENIOR, C. C. WARRINGTON AND R. C. DUTHIE, CONTRACTOR

After filling the slot-like dipping tank with a creosote mixture the sheep are completely immersed and swim through its 105-ft. length.

old town, stands alone a mile or two away from the relocated line and also a mile or so off the line of the Lincoln Highway. So voracious are tourists and others in this vicinity for wood that not a house and scarcely a piece of fire wood remains of the old historic town. So completely has nature restored the landscape to its original state that the monument is practically the only man-made feature left. Several movements have been put on foot to move the monument to Cheyenne but it is not practical because of the distance to the railroad and the immense size of the stones.

Unlike the ordinary road locator the highway engineers laying out the Lincoln Highway sought out the ridges, for it must be recalled that in Wyoming wind-blown snow fills depressions to incredible depths, even though the amount of the fall is comparatively light. In consequence practically all of the roads are made in fill. More than half a dozen routes were surveyed over the hill before the present satisfactory location was found. The engineers visited these locations all winter long to locate the route which retained the least snow. Making all of the road in fill has its difficulty for the contractor inasmuch as the wind frequently carries away this fill, especially if it happens to be of fine material, nearly as fast as he can build it up. Thus the costs per cubic yard mount up. In some places there is so little disintegrated material on top of the comparatively solid rock that it is difficult to get the prescribed side ditch required by the Bureau of Public Roads.

The trip to see the sheep dipping tank proved to be a mild adventure for on the way back to the Lincoln Highway the numerous unfenced roads looked so much alike that even the deputy state highway engineer got off the trail 5 to 10 miles. For cross-country cruising one needs more than a sense of direction. A tar-bucket memory as to the formation of prairie-dog villages and sage-brush clumps is a much better guide. There is a limit to the number of miles per gas-tank measure one may drive even a Dodge on so good a road as the disintegrated gravel of Sherman Hill. When the last ounce of gas had been drawn through the carburetor Mr. Warrington comforted me with the remark that statistics indicated that a car passed over this portion of the Lincoln Highway every 22 minutes. Thirty minutes after this observation a young rancher armed to the teeth against road robbers pulled up behind us and cautiously made friends. Ultimately, however, he generously drained a gallon of gasoline from his flivver tank into a milk can top which he poured successfully into our tank through a funnel improvised out of an *Engineering News-Record* envelope.

Just over the top of the hill one passes out of the granite into a distinctly different geological formation producing a sticky mud. Not all of this new road with its continuous grade for 9 miles into Laramie has yet been covered with the Sherman Hill gravel, but it is in good condition.

Fortunately, the gas shortage experienced on top of the hill did not prevent our getting into Laramie in time to observe that the main highway entrance paved with disintegrated granite was at least as good as the country road. Too many cities over the country leave a stretch of decidedly poor going near their boundary lines. Illinois has been boasting for a year of two routes of concrete from Chicago to St. Louis, but woe be the driver who in the spring forgot that country concrete is one thing and municipal mud quite another.

It would be interesting to detail the road conference at Laramie held until midnight between the engineer from headquarters and the man on the job. There are thousands of just such informal discussions between chief and assistant taking place over the country continually. Everything is discussed from salary raising to the question of how to handle the influential farmer who would be a contractor and annex some of the good money the state and federal government is spending mostly for his own benefit. Line and grade are not neglected, neither are entirely new routes, nor the maintenance of the old ones within the budget estimates. No one pays for these overtime midnight conferences; no one but the engineer himself. Nevertheless the results show in the efficiency of the year's work. Truly, the West is getting more intense and efficient engineering than it ever got before and the engineers on the job are having the time of their lives. They are living over again the experiences of their railroad brethren of the eighties. They are full of the consciousness of achievement. As I dozed off in the Pullman on the way to Salt Lake I could not help recalling the remark of one of my first chiefs who said that engineers were the happiest individuals in the world because their profession furnished them their pastime.

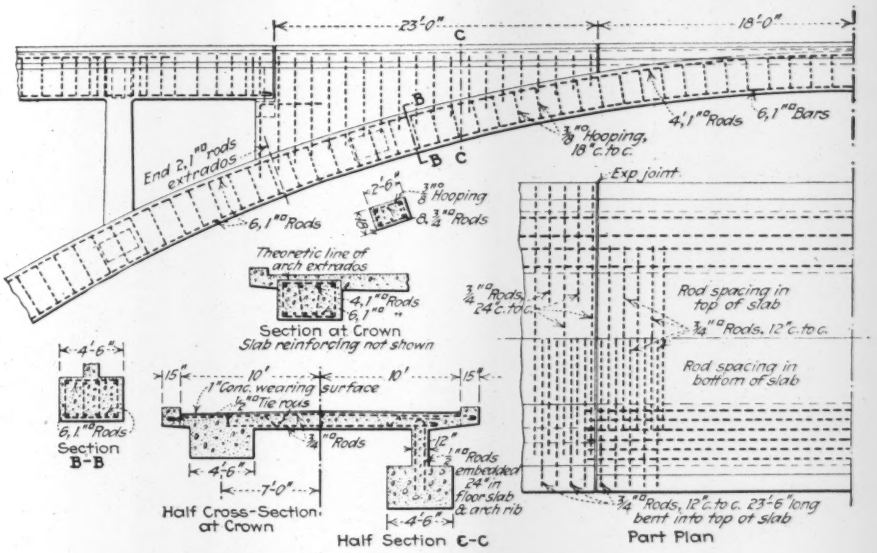
## Concrete Arch Rib and Floor Combined at Crown

In the Cienega Creek Bridge built by the Arizona State Highway Department, the main span is a 146-ft. reinforced-concrete arch in which the floor system for some distance on either side of the crown is made integral with the arch rib, as shown in the accompanying view and detail drawings, with a consequent reduction in depth there and some simplification in construction.

The floor slabs on either side of the crown section have but two supports—the spandrel walls—and just two supporting beams over the open spandrel sections. This gives a somewhat longer span with consequent deepening of slab than is usual for floor slabs of this class but this was more than paid for by the resulting ease of form construction.

The bridge was designed for the dead-load plus a live-load of two 15-ton trucks, plus 30 per cent impact, or 150 lb. per square foot distributed live-load. Temperature variation of plus or minus 45 deg. F. was taken into account and numerous roadway expansion joints were provided.

The bridge was designed by Merrill Butler, bridge engineer of the department under the direction of Thomas Maddock, state engineer.




DETAILS SHOWING CONJUNCTION OF FLOOR AND RIB

### Costs of Federal-Aid Highways

Average costs covering 11,017 miles of federal-aid highways, as detailed below, were given by Thomas H. MacDonald in an address delivered before the annual meeting in Washington of the Chamber of Commerce of the United States.

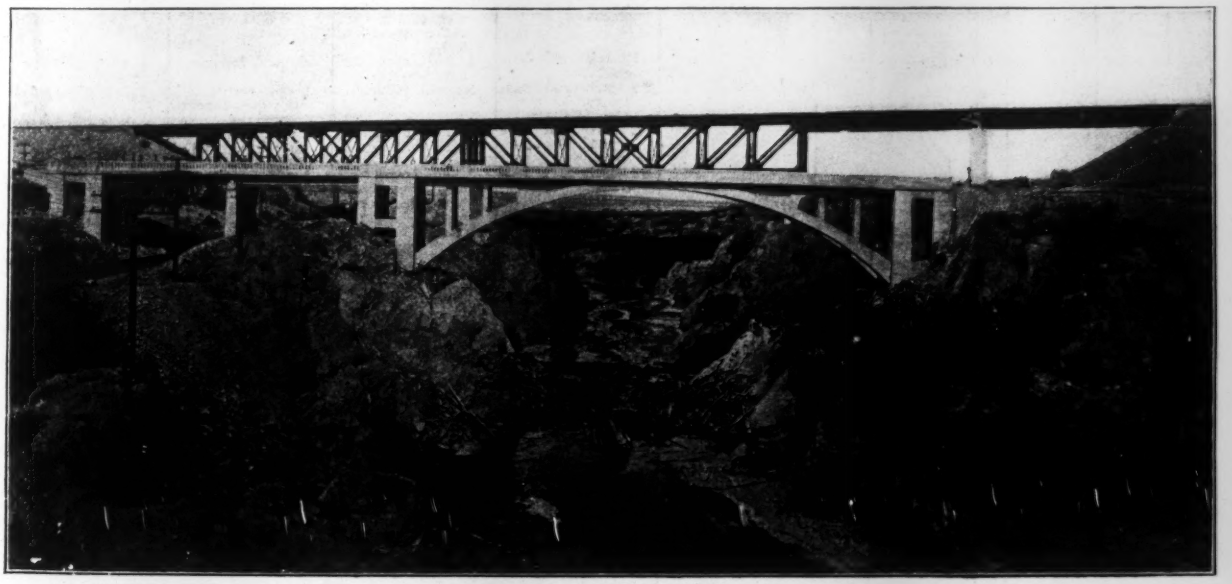
Class 1, including the graded and drained, the sand-clay and gravel types, average cost $11,320 per mile.

Class 2, covering macadam, waterbound and bituminous types, $20,540 per mile.

Class 3, covering the bituminous concrete, portland cement concrete, and brick types, $36,100 per mile.

It does not follow, Mr. MacDonald pointed out, that because the average cost of Class 1 roadway is only one-third that of Class 3 roadways that Class 1 should be built to the exclusion of the other.

The Class 3 roadways, he said, are capable of rendering many times the service that the Class 1 types are able to give.



THE CIENEGA CREEK BRIDGE NEAR TUCSON, ARIZ.

## Results of Tests of Bates Experimental Road in Illinois After Fifth Traffic Run Was Completed, July 1, 1922

(■ *indicates complete failure*)

| Section | Wearing Course Thickness, In. | | Base Course, In. | Coarse Aggregate | Mix | Traffic Run No. 1 (Rear wheel load, 2,500 lb.) Total trips, 1,000 | Traffic Run No. 2 (Rear wheel load, 3,500 lb.) Total trips, 3,200 | Traffic Run No. 3 (Rear wheel load, 4,500 lb.) Total trips, 3,000 | Traffic Run No. 4 (Rear wheel load, 5,500 lb.) Total trips, 3,000 | Traffic Run No. 5 (Rear Wheel load, 6,500 lb.) Total trips, 3,000 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Brick | Cushion | | | | | | | | |
| **Lug and Lugless Brick, Bituminous Filler, Macadam Base.** | | | | | | | | | | |
| 1A | 3, lug | 2, sand | 4 | Cr. limestone | | | ■after 1,000 loads. | | | |
| 1B | 3, lugless | 2, sand | 4 | Cr. limestone | | | ■after 1,000 loads. | | | |
| 2 | 4, lug | 2, sand | 4 | Cr. limestone | | | ■after 1,000 loads. | | | |
| 3 | 4, lug | 2, sand | 4 | Cr. limestone | | | ■after 1,000 loads. | | | |
| 4 | 4, lugless | 1, mastic | 8 | Cr. limestone | | | ■after 1,500 loads. | | | |
| 5 | 3, lugless | 2, mastic | 8 | Cr. limestone | | | ■after 1,500 loads. | | | |
| **Asphaltic Concrete, Macadam or Novaculite Base.** | | | | | | | | | | |
| 6 | 2, Topeka | | 10 | Macadam | | | 3 failures. | ■3 Add. failures; has reached max. carrying cap. | 5 add. points incip. failure; max. carrying cap. reached, third test. | Failed under third test. |
| 7 | 2, Topeka | | 8 | Macadam | | | ■6 failures, decisive. | 8 failures, 9 incip. failures; max. carrying cap. exceeded. | 2 add. points failure; 5 add. pts. incip. failure. | |
| 8 | 1½, Topeka<br>1½, binder | | 5 | Macadam | | | No failures. | 2 add. points incip. failure. | 2 add. points incip. failure. | 7 add. pts. of failure; max. cap. reached. |
| 9 | 2, Topeka | | 6 | Macadam | | | 6 points incip. failure. | 2 add. points incip. failure. | ■11 pts. add. failure; 5 pts. add. incip. failure. | |
| 10 | 2, Topeka | | 4 | Novaculite | | ■after 800 loads | after 3,200 loads. | | | |
| 11 | 2, Topeka | | 4 | Macadam | | 3 failures. | | | | |
| **Asphaltic Concrete, Portland Cement Concrete Base, 6-in. curbs.** | | | | | | | | | | |
| 12A | 2, Topeka | | 4 | Cr. limestone | 1:3:5 | | Cracks thru curb. | No. add. breaks; curb cracks not serious. | ■1 corner failure; decisive break. | 3 add. corner failures; 2 add. cracks; failed fourth test. |
| 12B | 2, Topeka | | 5 | Cr. limestone | 1:3:5 | | Cracks thru curb. | No. add. breaks; curb cracks not serious. | No add. failures. | No add. failures. |
| 13 | 1½, Topeka<br>1½, binder | | 4 | Cr. limestone | 1:3:5 | | Cracks thru curb. | 1 add. curb crack; previous curb cracks not serious. | 1 corner failure; decisive break. | 1 add. crack in curb and base. |
| 14 | 2, Topeka | | 4 | Cr. limestone | 1:2:3½ | | 1 corner break, curb cracks. | 1 add. curb and base crack; previous cracks not serious. | ■1 add. corner failure; decisive. | 1 add. corner failure; failed under fourth test. |
| 15 | 1½, Topeka<br>1½, binder | | 4 | Cr. limestone | 1:2:3½ | | No failure, 2 curb cracks. | No add. failures. | ■1 corner failure; decisive. | 1 add. corner failure; 2 curb and base cracks; failed fourth test. |
| 16 | 2, Topeka | | 5 | Cr. limestone | 1:3:5 | | No failure. | No. add. failures. | No failures. | 1 corner failure, decisive. |
| 17 | 2, Topeka | | 5 | Cr. limestone | 1:2:3½ | | No failure. | No. add. failures. | No add. failures. | No add. failures. |
| 18 | 1½, Topeka<br>1½, binder | | 5 | Cr. limestone | 1:2:3½ | | No failure. | No add. failures. | 1 corner failure; decisive break. | No add. failures. |
| 19 | 2, Topeka | | 6 | Cr. limestone | 1:3:5 | | No failure. | No add. failures; 1 curb crack. | No. add. failures. | No add. failures. |
| 20 | 2, Topeka | | 6 | Cr. limestone | 1:2:3½ | | No failure. | No add. failures | No failures. | No add. failures. |
| 21 | 2, Topeka | | 7 | Cr. limestone | 1:2:3½ | | No failure. | No add. failures. | 1 corner failure; not decisive. | 1 add. corner failure; not decisive. |
| 22 | 1½, Topeka<br>1½, binder | | 8 | Cr. limestone | 1:2:3½ | | No failure. | No add. failures. | No failures. | No failures. |
| **Lug and Lugless Brick, Bituminous Filler, P. C. Conc. Base, 6-in Curbs.** | | | | | | | | | | |
| 23A | 3, lug | 1, sand | 6½ | Cr. limestone | 1:2:3½ | | No failures. | No add. failures. | No add. failures. | No add. failures. |
| 23B | 3, lugless | 1, sand | 6½ | Cr. limestone | 1:2:3½ | 3 pts. partial failure. | No failures. | No add. failures. | No add. failures. | No add. failures. |
| 24 | 3, lug | 1, sand | 5½ | Cr. limestone | 1:2:3½ | | No failures. | No add. failures. 1 curb. crack. | No add. failures. | No add. failures. |
| 25 | 3, lugless | 1, mastic | 5½ | Cr. limestone | 1:2:3½ | | No failures. | No add. failures. | No add. failures. | No add. failures. |
| 26A | 4, lug | 1, sand | 4 | Cr. limestone | 1:2:3½ | | 2 curb and base cracks. | 1 add. corner break; max. cap. reached under second load test. | Previous damage not decisive. | 1 progressive break. |
| 26B | 4, lugless | 1, sand | 4 | Cr. limestone | 1:2:3½ | | 1 curb and base crack. | 1 add. curb and base crack. | No add. failures. | 1 curb and base crack. |
| 27 | 3, lug | 1, sand | 4½ | Cr. limestone | 1:2:3½ | | ■2 curb and base cracks. | No add. failures. | 1 add. corner failure; cap. reached second test. | Failed second test. |
| 28 | 3, lugless | 1, sand | 4½ | Cr. limestone | 1:2:3½ | | 2 curb and base cracks. | ■1 corner failure; decisive. | 1 add. corner failure; cap. reached third test. | Failed third test. |
| 29A | 3, lug | 1, sand | 4½ | Cr. limestone | 1:3:5 | | ■2 curb and base cracks. | 2 add. corner failures; 1 curb. and base crack; limit reached prev. test. | 1 add. corner failure; considered failed second test. | Failed second test. |
| 29B | 3, lugless | 1, sand | 4½ | Cr. limestone | 1:3:5 | | 3 curb and base cracks. | No add. failures. | No add. failures. | 2 corner failures, decisive. |
| 30 | 3, lug | 1, sand | 3½ | Cr. limestone | 1:2:3½ | | ■2 corner failures and 1 break (decisive). | 1 add. corner failure; 1 curb and base crack; limit reached prev. test. | 1 add. curb and base crack; considered failed second test. | 3 add. corner failures. Failed second test. |
| 31 | 3, lugless | 1 s'd-cem. | 3½ | Cr. limestone | 1:2:3½ | | 1 curb and base crack. | No add. failures. | No add. failures. | Progressive breaking. |
| 32A | 3, lug | 1, sand | 3½ | Cr. limestone | 1:3:5 | | 2 corner failures; 2 curb and base cracks; decisive. | 1 curb and base crack; limit reached under second test. | No add. failures. | Progressive breaking. |
| 32B | 3, lugless | 1, sand | 3½ | Cr. limestone | 1:3:5 | | 1 corner failure; 1 curb and base crack. | No add. failures; max. cap. not reached. | No add. failures. | 1 add. corner failure, decisive. |
| **Lug Brick, Monolithic and semi-Monolithic, P. C. Conc. Base.** | | | | | | | | | | |
| 33 | 3, monolithic | | 2 | Cr. limestone | 1:2:3½ | ■Initial corner brks. | 3 initial corner failures; critical load previously reached | Decisive failure under first test. | | |
| 34A | 3, semi-monolithic<br>¼ cem.-sand | | 2 | Cr. limestone | 1:2:3½ | 11 corner failures. | ■4 corner cracks. | Considered failed under second test. | | |
| 34B | 9 Conc. Intersection | | | Not a test section. | | | | | | |
| 35 | 4, monolithic | | 2 | Cr. limestone | 1:2:3½ | 2 corner failures. | ■1 add. corner failure; 2 corner breaks; decisive failure. | Considered failed under second test. | | |

# Traffic Tests of Bates Experimental Road Summarized

## Five Runs Completed—Rear Wheel Loads Vary from 2,500 to 6,500—Sixth Run in Progress

RESULTS of tests of the 63 sections of the 2-mile Bates experimental road near Springfield, Ill., are presented herewith in the form of a table covering five traffic runs, the last of which was completed July 1, 1922. As recorded in the news section of *Engineering News-Record* April 20, 1922, p. 667, the first run, completed in April, covered 1,000 trips of motor trucks with a load of 2,500 lb. on each rear wheel and 2,250 lb. on each front wheel. It was followed by four other runs in which the rear-wheel load was increased progressively by 1,000 lb., amounting to 6,500 lb. in the fifth run, as shown in the following summary of traffic conditions:

| Traffic Run No. | Rear Wheel, Load, Lb. | Front Wheel, Load, Lb. | No. of Trips, Night | No. of Trips, Day | Path of Travel |
|---|---|---|---|---|---|
| 1 | 2,500 | 2,150 | | 1,000 | Each edge of pavement. |
| 2 | 3,500 | 2,150 | 1,033 | 2,167 | 627 day trips on edges; 1,540 and 1,033 night trips; 2 ft. 6 in. from north side and on edge of south side. |
| 3 | 4,500 | 2,000 | 1,000 | 2,000 | 2 ft. 6 in. from north side and on edge of south side. |
| 4 | 5,500 | 1,900 | 1,000 | 2,000 | Same as for 4,500-lb. load. |
| 5 | 6,500 | 1,800 | 1,000 | 2,000 | Same as or 4,500-lb. load. |

The length of the Bates road is 10,800 ft. and its width is 18 ft. It consists of 63 sections, most of them 100 or 200 ft. long, surfaced with brick, asphaltic concrete and portland cement concrete of various types. The subgrade is a brown silt loam.

The results thus far indicate that if the line of traffic can be held away from the edges of pavements fewer failures will occur than when the truck wheels pass directly on the edge. It has been noted, also, that

| Section | Wearing Course Thickness, In. | Base Course, In. | Coarse Aggregate | Mix | Traffic Run No. 1 (Rear wheel load, 2,500 lb.) Total trips, 1,000 | Traffic Run No. 2 (Rear wheel load, 3,500 lb.) Total trips, 3,200 | Traffic Run No. 3 (Rear wheel load, 4,500 lb.) Total trips, 3,000 | Traffic Run No. 4 (Rear wheel load, 5,500 lb.) Total trips, 3,000 | Traffic Run No. 5 (Rear Wheel load, 6,500 lb.) Total trips, 3,000 |
|---|---|---|---|---|---|---|---|---|---|
| 36 | 3, monolithic | 3 | Cr. limestone | 1:3:5 | 3 corner failures. | 1 corner crack; not decisive. | ■2 corner failures, decisive; max. capacity exceeded. | Progress in failures 5 points. | Failed third test. |
| 37 | 3, monolithic | 3 | Cr. limestone | 1:2:3½ | 1 corner failure. | No further breaks. | ■1 corner failures; approaching limit. | 4 add. corner failures; cap. reached third test. | Failed third test. |
| 38 | 4, monolithic | 3 | Cr. limestone | 1:2:3½ | | Break in surface only; not decisive. | 1 corner failure, decisive; 1 interior surface break. | 2 add. corner breaks. | 2 add. corner failures. |
| 39 | 4, monolithic | 4 | Cr. limestone | 1:3:5 | | No failures. | 4 breaks, not decisive. | 3 corner failures; decisive. | 1 add. corner failures. |
| Portland Cement Concrete. | | | | | | | | | |
| 40 | 9 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | 2 short cracks. |
| 41[1] | 8 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | 3 short cracks. |
| 42 | 8 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | 3 cracks, center to edge. |
| 43[1] | 7 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | No failure. |
| 44 | 7 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | 1 corner break. |
| 45[1+2] | 6 (reinf.) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | 2 corner failures. |
| 46[1+2] | 6 (reinf.) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | No failures. |
| 47[1+2] | 6 (reinf.) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | 1 short crack. |
| 48 | 5 (reinf.) (same as No. 45) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | No failures. |
| 49 | 5 (reinf.) (Same as No. 46) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | No failures. |
| 50 | 5 (reinf.) (Same as No. 47) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | 3 transv. cracks. | 1 corner failure; 2 cracks. |
| 51[3] | 6 (reinf., wire) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | No failures. |
| 52 | 6 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | 2 small cracks. | Extension of old cracks. |
| 53[3] | 5 (reinf., wire) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | 3 cracks. | 1 corner failure; 1 crack. |
| 54 | 5 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | ■3 corner failures; apparently decisive failure. | 4 add. cracks. Failed fourth test. |
| 55 | 5 (plain) | | Gravel | 1:2:3½ | | ■1 corner failure. | 2 corner failures, decisive; capacity reached under second test. | 1 add. corner failure; several cracks; failed second test. | |
| 56A | 5 (plain) (4% Cal. chloride) | | Cr. limestone | 1:2:3½ | | No failures. | ■1 corner failure. | Failed decisively, third test. | |
| 56B | 5 (plain) (2½% Cal. chloride) | | Cr. limestone | 1:2:3½ | | 1 corner failure, decisive. | Several new cracks, not decisive. | Additional cracks. | ■3 add. cracks. Considered failed, fifth test. |
| 57 | 5 (plain) (Cemite cement) | | Cr. limestone | 1:2:3½ | | 1 corner failure (decisive.) | ■1 corner failure, decisive; failed decisively. | | |
| 58 | 4 conc. / 4 stone base | | Cr. limestone | 1:2:3½ | 2 corner failures. | No failures. | 1 add. corner failure; not decisive. | ■2 add. corner failures. | 2 add. corner failures. Failed fourth test. |
| 59 | 4 (plain) (Cemite cement) | | Cr. limestone | 1:2:3½ | 2 corner failures. | ■2 add. corner failures prog. breaking decisive. | 3 add. corner failures; considered failed under second test. | | |
| 60 | 4 (Cal. chloride added) | | Cr. limestone | 1:2:3½ | | No failures. | ■2 corner failures; considered failed decisively. | 5 corner failures. | |
| 61A | 4 (Hyd. lime added) | | Cr. limestone | 1:2:3½ | | ■1 corner failure, decisive. | 2 corner failures; reached limit under second test. | 3 add. corner breaks; 3 cracks; failed second test. | |
| 61B | 4 (plain) | | Cr. limestone | 1:2:3½ | | No failures. | ■2 corner failures, decisive; considered decisively failed. | 1 add. corner failure; 1 crack. | |
| 62[4] | 4 | | Cr. limestone | 1:2:3½ | | 1 corner failure. | ■2 corner failures, decisive; considered failed decisively. | 3 corner failures. | |
| 63A[4] | 7 | | Gravel | 1:2:3½ | | No failures. | No failures. | No failures. | 1 transv. crack. |
| 63B[4] | 7 | | Cr. limestone | 1:2:3½ | | No failures. | No failures. | No failures. | No failure. |

Note 1. Tr. and long. dividing planes formed by strips of corr. gal. iron.
Note 2. Bar reinf. ¾ in. placed 2 in. from top and 6 in. from edges.
Note 3. Wire mesh, 45 lb. per 100 sq.ft.
Note 4. Long. joint full length of section; ¾-in. bars, 5 ft. long, and 10 ft. centers across long. joint; ¾-in. bars 6 in. from edges.

greater damage to pavements occurs during night traffic when the pavement edges are curled away from the subgrade, than dur.ng daytime traffic.

Following the fifth run the load now being applied is 8,000 lb. on each rear wheel and 1,930 lb. on each front wheel. As this load is the legal limit for the State of Illinois it is intended to make 10,000 applications so that a thorough test can be given all remaining sections of the road.

The tests are being conducted by the Illinois State Division of Highways, Clifford Older, chief engineer.

## Bridge Abutment Crumbles, Wrecking Span

By C. S. Stewart
Milwaukee, Wis.

After standing for 30 to 40 years, the north abutment of the Humboldt St. bridge across the Milwaukee River in Milwaukee collapsed recently. We are accustomed to expect that such masonry structures will remain forever without attention unless wrecked by flood, storm, or accident, but this abutment, after successfully withstanding many seasons of ice and flood without showing signs of weakness, quietly crumbled dropping the end of the bridge truss into the river.

ABUTMENT FAILURE NOT DUE TO HIGH WATER
Upper view, looking downstream; at right is the abutment whose face wall crumbled.
Lower view, floor stringers of fallen span forced upward while trusses went down when the bearing masonry failed.

Cracks were first seen to appear late in April, about two weeks before the collapse, and the bridge was immediately closed. Neither at the time of the failure nor during the preceding spring months was the water in the river unusually high. It is possible that the failure may have been caused by a bulging of the wall due to freezing, to scouring during some past high water, to uneven settling, or to a combination of all of these conditions.

The abutment was of a soft grade of limestone in use in this locality about 40 years ago. The stone shows the effects of weathering. The truss, except for the last panel, appears to have suffered little damage.

## Fire Pressure a Function of Fire Rather Than Water Department

That the duty of the water-works department should stop with supplying water of sufficient pressure for domestic service and that the provision of pressures for use during fire should be the function of the fire department by means of fire engines is contended by Charles R. Henderson, manager of the Davenport (Ia.) Water Co., in the *Journal* of the American Water Works Association for July. The advent of motor-driven fire apparatus carrying hose, men and tools and small and inexpensive pumps to fires, renders quite unnecessary, Mr. Henderson states, "the dangerous and wasteful practice of increasing pressure on hundreds of miles of water mains, every time there is an alarm of fire." Mr. Henderson cites the bursting of half of the 2-inch lead service pipes in use in one city owing to fire pressure, and the breaking of mains, 12 in., and over in diameter, in other cities, "virtually putting the water department out of business until such mains are shut off," as arguments in support of his contention. He also cites the case of a city of 50,000 population entirely without water for nearly an hour due to the shut down of an engine following a change in the adjustment of valves to effect a change in water pressure.

Mr. Henderson maintains that a pressure of 60 lb. is sufficient for domestic pressure for all but very high buildings and for small fires requiring only one or two lines of hose.

Statistics collected by Mr. Henderson and published in tabular form in the *Journal* show that the water pressures in 143 cities and having a population of more than 50,000 by the census of 1920 ranged for domestic purposes from 20 to 145 lb. per square inch in commercial districts, and from 25 to 125 lb. in residential districts. The average pressure reported was 68 lb. in commercial and 56 lb. in residential districts. Not over 25 per cent of the cities in the list increase pressure at times of fire. Where pressure is increased the range is from 4 to 55 lb. with an average of 24 pounds.

Already the Illinois and the Iowa sections of the American Water Works Association, and the Indiana Sanitary and Water Supply Association have adopted resolutions, Mr. Henderson states, "advocating the discontinuance of raising pressure during fire." Mr. Henderson adds that "it is strange that such a reasonable and apparently necessary reform was not started sooner"

## Highway Work in Minnesota During 1921

Minnesota highway work during 1921 benefited 3,393 miles of main routes, while patrol and maintenance service was given on 6,855 miles of the 7,000-mile system of state trunk highways—all exclusive of betterments on the secondary or so-called farmer roads. Paving built last year measured 109 miles, compared with 112 laid in previous years combined; and 765 miles of grading and 497 miles of gravel-surfacing were added to the respective 1,499 and 1,371 mile total listed as graded and gravelled when the state took over the trunk routes for improvement and perpetual upkeep. In addition, state maintenance forces re-shaped 1,137 miles and re-surfaced 885 miles on the trunk system. The Minnesota Highway Department last year planned and supervised projects representing an outlay of $19,321,238.60.

# Maximum Flood Discharges in Hawaii

By J. B. Lippincott
Consulting Engineer, Los Angeles, Cal.

In January, 1921, the Island of Oahu, Hawaii, was visited by heavy storms which resulted in excessive flood flows in all of the streams. The flood undermined and damaged the spillway of the Waiawa reservoir of the Waiawa Water Co., Ltd., which delivers irrigation water to sugar plantations on the western side of the island. The dam creating the reservoir is located on the Kaukonahua stream which heads in the Koolau mountains at El. 2,700 ft. above sea level. Water backs up two forks of the stream, which join immediately above the dam, 4 and 6 miles respectively. In connection with an investigation of the damaged spillway and preparation of plans and estimates for its reconstruction the writer made studies of the flood flows during this storm on most of the streams on the Island of Oahu.

The Water Resources Branch of the U. S. Geological Survey has maintained gaging stations on various streams on the Island of Oahu and on the other islands of the Hawaiian group, so that records are now available on some of the streams for the last seven years. The engineers in charge of this department were exceedingly helpful and courteous in placing at the writer's disposal all of these records. From the information available it is found that the storm of Jan. 16, 1921, was of much greater violence than that of any previously recorded on the Island of Oahu. James E. Stewart, district engineer of the Geological Survey, has furnished the data for the accompanying table, with the exception of the measurements made at the Waiawa dam and on the south fork of the Kaukonahua, which latter were furnished by Mr. Lairson of the Constructing Quartermaster's Department of the U. S. Army.

The shape of a drainage basin has much to do with the volume of runoff per square mile. It is difficult to draw accurate conclusions as to the probable flood volumes at the dam from floods in other basins. A comparison, however, is some indication as to whether this flood at Waiawa was an absolute maximum as compared with other basins similarly situated. A map of the Island of Oahu showing streams herein mentioned is contained in *Water Supply Paper* No. 318, Plate XII.

The runoff per square mile from small drainage areas, other things being equal, is slightly greater than from larger ones. The drainage basin of the Manoa, situated at the southern end of the island and for which flood measurements are recorded in the table, is such as to produce a greater concentration of runoff at its gaging station than the large basin of the Kaukonahua. Consequently, one would not be justified in applying to the Kaukonahua the large runoff per square mile indicated from these smaller fan-shaped basins. The flood discharges for Jan. 16, 1921, are in excess of any actual records in the files of the Geological Survey where the drainage area is known. For a larger drainage area a flood which occurred on Jan. 16, 1920, on the south fork of Wailua stream near Lihue, Kauai, is of interest. The peak discharge of this flood was estimated at 45,000 sec.-ft. or at the rate of 30,000 m.g.d. from 23 sq.miles.

In collaboration with Mr. Stewart the author has estimated from the hydrographs of the Geological Survey that there was a sustained flow for a period of 11 hours of 2,881 sec.-ft. from the 17½ sq. miles of the Kaukonahua drainage basin on Jan. 16, 1921. It has also been estimated that the maximum aggregate flood waves from the 4½ sq. miles at the head of the Kaukonahua amounted to 7,220 sec.-ft. or a rate of 4,640 m.g.d. The following details on this flood are of interest:

FLOOD DISCHARGES OF HAWAIIAN STREAMS

| Stream | Place | Date | M.G.D. | Sec.-Ft. | Authority | Area Sq. Miles | Sec.-Ft. per Sq. Mile | Remarks |
|---|---|---|---|---|---|---|---|---|
| East Branch, Manoa | Honolulu | Jan. 16, 1921 | 2,000 | 3,090 | Stewart | 1.1 | 2,810 | Maximum |
| West Branch, Manoa | Honolulu | Jan. 16, 1921 | 2,100 | 3,250 | Stewart | 1.0 | 3,250 | Maximum |
| Nuuanu | Reservoir 4, Honolulu | Jan. 16, 1921 | 1,100 | 1,700 | Stewart | 1.5 | 1,132 | Below reservoir |
| Kaneohe | Oahu, No. side of Pali | Jan. 16, 1921 | 7,100 | 11,000 | Austin | 5.3 | 2,070 | Circular basin |
| Nuuanu | Reservoir 4, Honolulu | Feb. 11, 1907 | 1,500 | 2,400 | Schuyler | 1.5 | 1,600 | Rain 6.89 in. in 24 hr. No storage then |
| Wailua | South Fork near Lihue, Kauai | Jan. 16, 1920 | 29,100 | 45,000 | Stewart | .23 | 1,955 | Rating curve—Basin L 2 width |
| Kaukonahua | Right Branch, North Fork, Oahu | Jan. 16, 1921 | 436 | 671 | U. S. G. S. | 1.2 | 559 | 11 hr. sustained flow |
| Kaukonahua | Left branch | Jan. 16, 1921 | 807 | 1,250 | U.S.G.S. | 1.5 | 833 | 11 hr. sustained flow |
| Kaukonahua | South Fork | Jan. 16, 1921 | 618 | 960 | Est. Stewart | 10.2 | 94 | 11 hr. sustained flow |
| Kaukonahua | Total for three Forks | Jan. 16, 1921 | 1,860 | 2,881 | Est. Stewart | 17.5 | 164.7 | 11 hr. sustained flow |
| Kaukonahua | Waiawa Waste | Jan. 16, 1921 | 2,580 | *4,000 | Wilson and J.B.L. | 17.5 | 228 | Max. channel $n=0.014$ |
| Nuuanu | U. S. G. S. gage | Jan. 16, 1921 | 2,150 | 3,334 | J.B.L. | 3.5 | 952 | 3 reservoirs above |
| Kaukonahua | Left Branch, North Fork | Jan. 16, 1921 | 1,815 | 2,820 | U.S.G.S. | 1.5 | 1,880 | Maximum |
| Kaukonahua | Right Branch, North Fork | Jan. 16, 1921 | 937 | 1,450 | U.S.G.S. | 1.2 | 1,210 | Maximum |
| Kaukonahua | South Fork | Jan. 16, 1921 | 1,900 | 2,950 | Harrison | 1.8 | 1,640 | Maximum |
| Kaukonahua | Upper Dams Sum | Jan. 16, 1921 | 4,660 | 7,220 | J. B. L. | 4.5 | 1,605 | Maximum |
| Kaukonahua | Waiawa | Dec. 24, 1920 | 887 | 1,368 | J. B. L. | 17.5 | ..... | Volumetric rise |
| Kaukonahua | Waiawa | Mar. 23, 1920 | 860 | 1,325 | J. B. L. | 17.5 | ..... | Volumetric rise |
| Kaukonahua | Waiawa | Feb. 10, 1908 | 1,320 | 2,040 | J. B. L. | 17.5 | ..... | |
| Kaukonahua | Waiawa | Jan. 16, 1921 | 3,860 | **6,000 | J. B. L. | 17.5 | 343 | |

* Exclusive of 2,000 ± sec.-ft. stored in reservoir during 12-hr. rise.

** Inclusive of 2,000 ± sec.-ft. stored in reservoir during 12-hr. rise.

| | Sq. Miles | Sec.-Ft. | Sec.-Ft. per Sq. Mile |
|---|---|---|---|
| E. Branch of Manoa | 1.1 | 3,090 | 2,810 |
| W. Branch of Manoa | 1.0 | 3,250 | 3,250 |
| Total | 2.1 | 6,340 | 3,060 |
| KAUKONAHUA: | | | |
| Right branch, north fork | 1.2 | 1,450 | 1,210 |
| Left branch, north fork | 1.5 | 2,820 | 1,880 |
| South fork | 1.8 | 2,950 | 1,640 |
| Total | 4.5 | 7,220 | 1,605 |

Statements by old residents indicate that the flood in Manoa valley on Jan. 16, 1921, was larger than any in the last 40 or 50 years. It is uncertain however, how close the crest of this flood was to the absolute maximum. The rainfall at certain points in the Koolau mountains during the night of Jan. 15 and 16 exceeded 12 in., for one 12-in. gauge overflowed. Probably the rainfall did not exceed 20 in., however, for otherwise the amount of water in the monthly precipitation cans would have been greater. At Honomu (El. 1,200 ft.), Island of Hawaii, there was a rainfall of 31.95 in. Feb. 20, and 11.84 in. Feb. 21, 1918. At Hana, Island of Maui, there was 28.2 in. April 27, 1915, and it is said that 24 in. of this amount fell within three or four hours. These two records would indicate that greater floods than that of Jan. 16, 1921, may be expected in the islands.

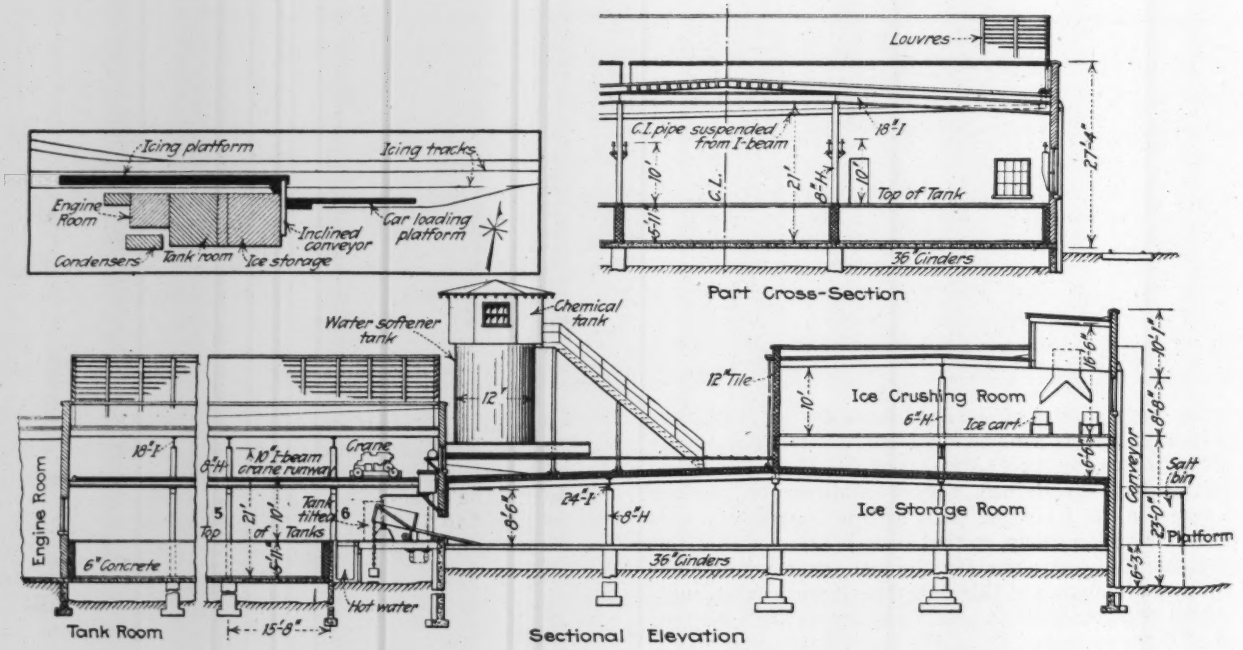
# Car Icing Station for the Belt Railway of Chicago

## Refrigerator Cars at Transfer Yard Supplied With Cake or Crushed Ice—Conveyors, Carts and Portable Chutes

FOR the icing of through refrigerator cars in transfer between trunk lines the Belt Railway Company of Chicago has established at its great freight yard at Clearing, Ill., an icing plant designed to produce an average of 300 tons of cake ice per day, or sufficient to supply approximately 300 cars daily. This plant, which has been laid out to provide for future expansion, includes equipment for handling also crushed ice and salt. Cake ice in 400-lb. blocks is used in cars carrying fruit, vegetables and certain other perishable products.

*Ice Manufacturing Plant*—A steel-frame building with brick walls and plank roof covered with tar and gravel contains the engine and compressor room 75 x 65 ft., tank or ice-making room 110 x 97½ ft. and ice storage room 100 x 97½ ft., as shown in Fig. 2. The tank room has three bays 32½ ft. wide and the greater part of its length is occupied by the tanks in which the cans of water are placed to be frozen into 400-lb. blocks by the brine system. Each bay has a 2-ton overhead electric crane to handle the cans.

In the delivery end of each bay there is a tank of hot water into which the crane dips the can in order to release the ice block. When the can is lifted out the crane carries it forward a little distance until the lower end engages a stop and the further movement of the crane tips the can over, discharging the ice into an inclined chute leading to the storage room floor. When the empty can is restored to its vertical position it stands under a pipe by which it is




FIGS. 1-2. CAR ICING STATION AND ICE MAKING, STORING AND CRUSHING PLANT; BELT RAILWAY OF CHICAGO

Crushed ice mixed with salt is used in cars carrying meat products.

Icing stations on trunk lines are arranged frequently for serving solid trains of refrigerator cars. At the Clearing yard, however, cars coming in from various trunk lines are classified and sorted for forwarding over other lines. Under these operating conditions, refrigerator cars collected in the eastbound and westbound receiving and classification yards are taken to the icing plant and thence to the departure yards to be made up in trains for the various roads. The plant comprises an ice manufacturing plant with storage room, an elevated platform between two tracks for delivering ice to the cars through the roof hatches, and a stub track with platform for loading box cars with ice in bulk for shipment. From this latter platform ice may be delivered also to wagons for local distribution. The general layout is shown in Fig. 1.

filled with water. The crane then carries it back and lowers it into the tank for freezing. Water for ice making is obtained from the Chicago city mains but is treated in a water-softening plant.

A 12-in. cork lining for the brick walls of the tank room is carried up to the tops of the tanks. In the storage room, the walls have a 6-in. cork lining and the ⅞-in. plank roof is covered with 6 in. of cork board over which is placed the composition roofing. The floor of the tank room has a 6-in. concrete slab on 3 ft. of cinders, and that of the storage room has 2-in. oak plank on 4 x 4-in. sleepers spaced 12 in. apart in a 3-ft. cinder fill.

A vestibule or air lock with double doors forms the main entrance to the storage room, the average temperature in which is about 26 deg. F. Men in this room stack the ice cakes or deliver them to the conveyors. The storage capacity is 2,000 tons. Openings for the

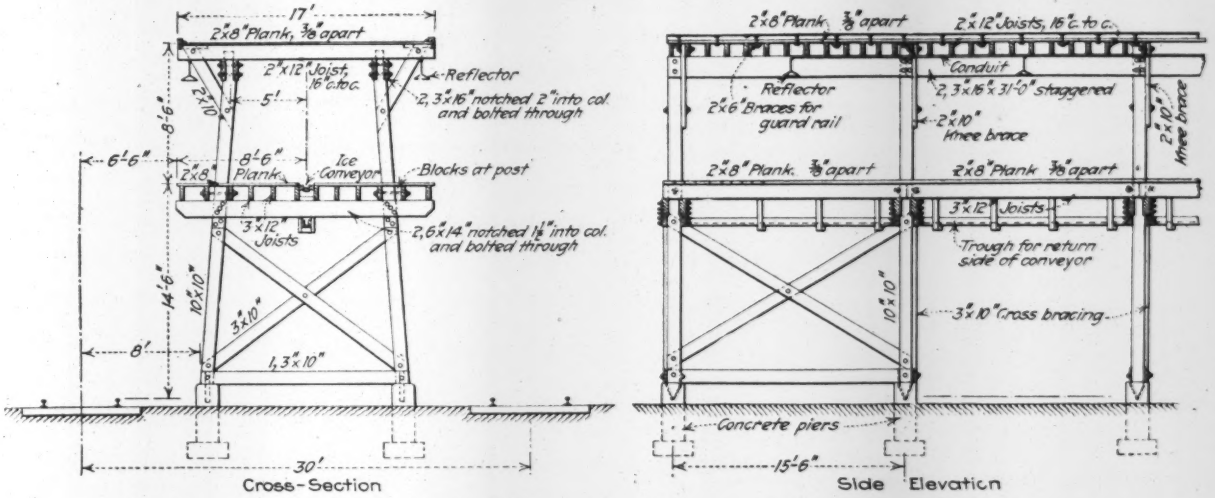



FIG. 3. DOUBLE-DECK PLATFORM FOR ICING REFRIGERATOR CARS

ice conveyors are fitted with vertical swinging doors which are raised by the ice cakes as the conveyors carry them through the opening. Above this room is an upper floor 66 x 51-ft. for the ice crushing plant, with an air space of about 6 ft. between the storage room roof and the upper floor.

*Icing Platforms*—For delivering ice to the cars there is a double-deck platform located between two tracks spaced 30 ft. c. to c. It is 400 ft. long to accommodate 10 cars on each track, but the layout will permit of increasing the length to 1,000 ft. for 25 cars on each track. The lower deck is a little above the level of the car roofs and on this the ice cakes delivered by a conveyor are handled by tongs, being slid over skids to the car hatches. On the upper deck crushed ice is handled in wheeled carts or tubs. The ice shipping platform along the stub track is at the level of the car floors. It is 11 ft. wide and 253 ft. long, accommodating six cars.

The double-deck icing platform is a frame trestle on concrete pedestals and has spans of 15½ ft. with decks 17 ft. wide, as shown in Fig. 3. The posts are notched for twin transverse caps at the lower deck and for twin longitudinal stringers at the upper deck. The two decks have longitudinal and transverse joists respectively, with 2 x 8-in. floor planking. Every fourth span has longitudinal diagonal bracing to form a tower. Curbs or wheel guards on the upper deck are of special construction to carry portable spouts for the crushed ice. The curb is a 3 x 4-in. timber bolted through the floor and covered by a steel strap fastened with screws. On the inner face is spiked a 2 x 2-in. angle with horizontal leg outstanding to form a shelf or rib.

*Ice Conveyors*—In the floor of the storage room are two motor-driven conveyors, each consisting of a single chain running on a maple plank in a shallow trough formed by two oak stringers on which the ice cakes slide. The flights are spaced 10 ft. apart and at a chain speed of 120 ft. per minute each conveyor can deliver twelve cakes per minute. One conveyor extends through a doorway and along the floor of the platform for shipping ice in cars. The other delivers the ice blocks by a curved chute to the lower end of an inclined conveyor at right angles to the first one and extending across the outside of the building.

This inclined elevator has a slope of about 1 on 3 for a length of 65 ft. and then a horizontal stretch of 25 ft. across the track to the upper deck of the icing platform. Changes of grade are made by vertical curves of about 22-ft. radius. From the upper end of the incline the cakes make a right-angle turn by means of a horizontal curved chute which delivers them to a descending incline leading to the lower deck. Both the ascending and descending conveyors are of the same type and inclination and are driven by the same motor.

A third chain conveyor of the same type and running

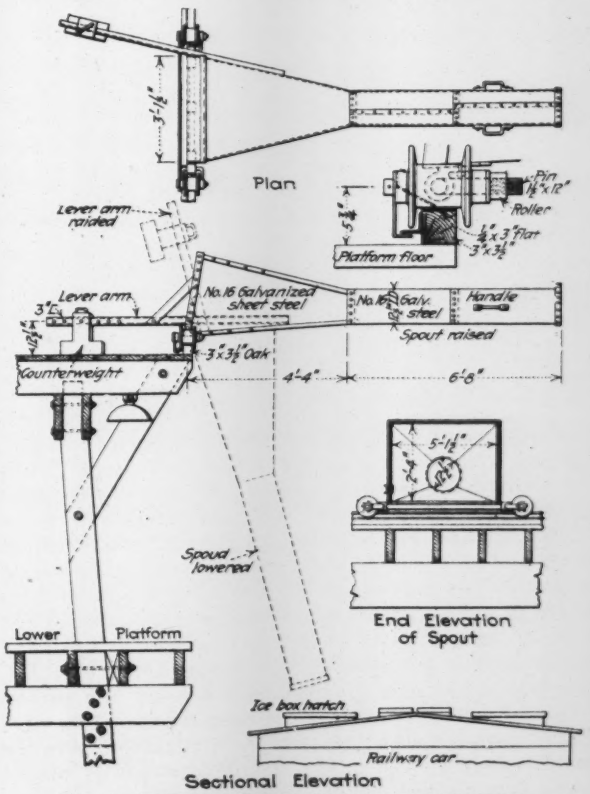



FIG. 4. PORTABLE SPOUT FOR DELIVERING CRUSHED ICE TO CARS

at the same speed but driven by a separate motor, extends along the lower deck of the icing platform. From this the men pull the cakes with tongs and slide them over skids to the roofs of the cars. At some icing stations the descent to the platform is made by inclined or spiral chutes, but for this plant the gravity movement of the cakes was considered likely to result in some loss by breakage. With the descending or retarding conveyor the blocks are lowered steadily and uniformly and cannot run away.

*Handling Crushed Ice and Salt*—From the head of the inclined conveyor, ice cakes may be diverted through a chute and delivered to a toothed-cylinder crusher on the second floor. Another inclined conveyor receives the crushed ice and carries it up to a bin of 4 cu.yd. capacity. This conveyor consists of maple flights 8 x 24-in., 3 ft. apart, carried by roller chains riding on the sides of a trough. At a speed of 100 ft. per minute it can handle 50 tons per hour, while the crusher capacity is 40 tons per hour. From the bin the crushed ice is discharged into steel wheeled carts or tubs of 900-lb. capacity by means of spouts fitted with radial counterbalanced hand-operated gates.

Traveling spouts, Fig. 4, deliver the crushed ice to the car hatches, the carts dumping into these spouts. Each spout is a 12½-in. galvanized pipe with a hopper top, and its upper end is hinged to a frame so that the spout can be swung in a vertical plane at right angles to the platform. A counterweighted arm is attached to the hopper. The frame is mounted on two grooved rollers which ride on the curb described above.

Coarse salt delivered in cars is elevated to a wooden storage bin by a vertical conveyor consisting of buckets attached to an endless belt. To resist the corrosive action of the salt the buckets are of malleable iron treated by the sherardising process. Spouts and gates similar to those on the crushed ice bin deliver the salt to wheeled carts which convey it to salt boxes placed on each side of the platform at every third bent. From these boxes the salt is shoveled into the car bunkers.

This car icing station was designed and built under the direction of F. E. Morrow, chief engineer of the Belt Railway of Chicago. The ice manufacturing plant was constructed and will be operated by the Railways Ice Co., Chicago. The buildings were designed by S. Scott Joy, architect. Ice making machinery was supplied by the Vilter Mfg. Co., Milwaukee, Wis., and the conveyor equipment, including portable spouts, by the Gifford-Wood Co., Hudson, N. Y.

## Flood Emergency Met by Federal-Aid Road

A federal-aid road has just been completed in Arkansas which, according to the U. S. Bureau of Public Roads, has already saved millions of dollars to the community in which it is built. Recently during high water in the Mississippi word came to Helena, Ark., that the levee at Old Town, 17 miles away, was about to break. The situation was critical. A few hours' delay and thousands of acres of rich farming land would be flooded and possibly many lives lost. Helena was the only source of aid and many men with tools and material were needed. Every available motor vehicle was pressed into service and over 600 men, properly equipped for the work, were in a short time speeding over the new road to save the levee. They arrived in the nick of time and by almost superhuman effort dammed the rising waters.

## Excess Dose, Thickeners and Carbonation at Water Treatment Plant

EXCESS treatment with lime, soda ash and alum combined, Dorr thickeners, sedimentation, carbonation and rapid filtration are to be practiced at the new 6-m.g.d. water softening and filtration plant at Newark, Ohio, contract for which has recently been let. The plant was designed by Charles P. Hoover, chemist-in-charge of water purification, Columbus, Ohio, assisted by Arthur R. Holbrook. The excess-chemical treatment is an extension of the excess-lime method of water disinfection described in Chapter V of Dr. (now Sir) Alexander Houston's "Studies in Water Supply," published in 1913, discussed by Charles P. Hoover and Russell D. Scott under the title "The Use of Lime in Water Purification" in *Engineering News* of Sept. 17, 1914, p. 586.

The excess treatment is obtained by overdosing a portion of the supply and subsequently mixing it with a larger and undosed part of the supply. Over-treatment gives the effect of mass action, resulting in the formation of large flocs and crystalline precipitates which are less soluble than colloidal precipitates formed when the treatment is not so complete and in consequence the water is not so soft.

At Newark 25 per cent of the water to be treated will be dosed with the lime, soda ash and alum in a tank having a 5-min. detention period during which the water will be vigorously agitated. This 25-per cent portion will then be commingled with the 75-per cent portion in a baffled mixing tank through which the water will pass with a carrying velocity of 0.4 ft. per second, the detention period being 60 minutes. The entire volume of water will be passed from the mixing tank to concentrating tanks equipped with Dorr thickeners where the water will remain for a nominal period of 22 min. The sludge gathered by the thickeners will be removed continuously so as to lessen the noticeable pollution of its discharge into the small stream that receives it. The extraction of as much as possible of the precipitate or sludge in the thickeners before the water passes to the settling basins will lessen the accumulation of sludge at the entrance end of the basins and thus make the basins utilizable to their full capacity all the time.

After a period of detention of eight hours in the settling basins the water will pass to a carbonation gallery located between the basins and the filters. This gallery will be a rectangular covered concrete tank, 15 by 20 ft. in plan by 6 ft. deep, provided with a false bottom of filtros plates. The $CO_2$ (produced by burning coke) combined with compressed air at the rate of 8 to 10 per cent of $CO_2$ to 92 to 90 per cent of air, will be forced through the filtros plates and absorbed by the water. Carbonation is for the purpose of preventing after-deposits of lime by making any residual colloidal lime soluble.

It is proposed to make some experiments on the efficiency of returning some of the sludge from the thickener to the large mixing tanks where the overdosed water is mixed with that to which chemicals have not been added, or to the smaller dosing and agitating tank. These experiments will be in the nature of a continuation of some carried out at Grand Rapids, Mich., by W. A. Sperry.

Quicklime will be used instead of hydrated lime.

It will be unloaded from the cars by a power shovel, elevated to bins and applied to the water by gravity through weighing and chemical-feed regulators. While a plant to handle quicklime costs more than one for hydrated lime, the designers hold that the savings in operation effected in a plant of this size justifies the additional first cost, estimated at 10 per cent. Quicklime available at Newark, Ohio, averages 90 per cent water soluble CaO while the hydrate averages 65 per cent. The average current price for hydrated lime paid by Ohio water-works plants is 0.65c. per pound while quicklime costs the Columbus plant 0.55c. On the basis of the CaO content, hydrated lime having the equivalent amount of CaO in 1 lb. of quicklime costs 0.91 cents.

## Delaware River Sewage Treatment Zones Fixed by Facing States

A JOINT uniform policy as to the required degree of treatment of sewage discharged into the Delaware River along that portion of the stream that divides New Jersey and Pennsylvania has been agreed upon by the departments of health of the two states after conferences between the engineers of the two departments. Under this agreement the river is divided into three sections or zones and the general treatment of sewage in each zone prescribed. In the upper zone a clarified and oxidized effluent is required; in the middle zone, removal of settleable matters by efficient sedimentation, with further treatment to safeguard public water supplies where needed; in the lower or tidal zone, sedimentation and deep submerged outlets are required, with further treatment if needed; to protect public water supplies.

The agreement is attested by Edwin Martin, commissioner of health of Pennsylvania, and by J. C. Price, director of health of New Jersey, as having been adopted by the respective departments on July 7 and 13. C. A. Emerson, Jr., is chief engineer and W. L. Stevenson is assistant chief engineer of the Engineering Division of the Pennsylvania Department of Health, and H. P. Croft is chief of the Bureau of Engineering of the New Jersey Department of Health.

The agreement in full is as follows:

1. Sewage discharged into the Delaware River from the northern limits of the states of Pennsylvania and New Jersey to a line above the City of Easton and the Town of Phillipsburg shall be treated to such an extent as to produce a clarified and oxidized effluent; and also, that so far as legally possible, the State Department of Health will prevent the discharge of untreated industrial wastes into this portion of the river.

2. Sewage discharged into the Delaware River from a line above the City of Easton and the Town of Phillipsburg to a line above the Borough of Morrisville and the City of Trenton shall be treated to such an extent as to effect the removal of settleable matter by means of efficient sedimentation; provided, however, that in cases where such settled sewage may be discharged into this portion of the river that it may prejudicially affect a water supply, the effluent shall be further treated to adequately safeguard the purified water supply obtained from the river; and further provided, that when plans for sewage treatment works are approved, where the sedimentation of sewage is the only treatment required under this policy, the approval shall be subject to the condition that means for the further purification of the tank effluent shall be installed when deemed necessary by the State Department of Health; and also, that so far as legally possible, the State Department of Health will restrict the discharge of untreated industrial wastes which might be a menace to public health or create a nuisance to either sight or smell.

3. Sewage discharged into the tidal portion of the Delaware River, from and including Morrisville and Trenton and to and including Philadelphia and Camden, shall be treated by means of sedimentation and the effluent discharged through submerged outlets into deep water in the Delaware River; provided, however, that in cases where such settled sewage is or would be discharged into the said tidal portion of the Delaware River at such a distance above or below a water-works intake that it may prejudicially affect such water supply, the effluent shall be further treated to adequately safeguard the purified water supply obtained from the river; and further provided, that when plans for sewage treatment works are approved, where sedimentation of sewage is the only treatment required under this policy, the approval shall be subject to the condition that means for the further purification of the tank effluent shall be installed when deemed necessary by the State Department of Health.

3-A. From data now available it is considered that the discharge of only settled sewage into the aforesaid tidal portion of the Delaware River within two miles of a water-works intake of an efficient filtration plant may prejudicially affect such water supply.

4. In case the said point of sewage discharge is from one State and the said water-works intake is in the other State, so that the sewage effluent while discharged within the aforesaid two miles would have to cross the river to reach the water intake, then before a decision is reached by the State Department of Health having jurisdiction over the discharge of sewage, the case shall be taken up with the other State Department of Health for a careful determination of the probability of the discharge of only settled sewage prejudicially affecting the water supply.

## India Needs Special Pumps for Irrigation

The Indian correspondent of *The Engineer*, London, reports a considerable problem in providing suitable pumps driven by oil, gas, or steam engines for irrigation purposes. Although many plants are operating successfully in capacities ranging from 6,000 gal. per hour upwards, the design of suitable power pumping plants which can compete with animal power in handling small quantities presents considerable difficulty. Owing to the small available capital, first cost must be very low, while, because of the lack of knowledge of machinery on the part of cultivators, simplicity and reliability of both pump and engine are essential. The following points have been emphasized. The standard kerosene oil engine has done very well, but kerosene has become so expensive that cheaper fuel is sought. Liquid fuel, though advanced in price, does well in larger oil engines but it is doubtful if it is as yet satisfactory in engines of 2, 3, or 4 brake horsepower. Suction gas engines working with charcoal may be the solution for small plants. Blow lamps for starting give much trouble under rough use and something stronger than the usual pattern is needed. Small lubricating pipes and glass lubricators soon give out. Moving parts should be incased to protect them from dust and magnetos should be in waterproof cases. Ordinary types of reciprocating pumps are not satisfactory, as there are too many small parts. Glands, cup-leathers and leather-face are rarely treated properly by unskilled natives. Strength, simplicity and cheapness are essential.

# Concrete Road Reinforced with Job-Assembled Mats

## Shop Cut and Bent Bars and Ties Received in Bundles and Assembled on the Job Into Rigid Reinforcing Mats

REINFORCING mats assembled on the job from shop fabricated members have been adopted for a special 20-ft. concrete road in New Castle County, Delaware. A section of the roadway and pavement is shown by Fig. 1 The slab is separated at the middle by a construction joint, but transverse joints are made only at the end of a day's run, or where for some other reason a stop is required in the continuity of the slab. As indicated by Fig. 2, dowels are employed at these transverse joints. No metal whatever spans the longitudinal joint.

Each side slab is reinforced by mats 11½ ft. long and 9 ft. 8 in. wide with members arranged as shown by Fig. 2. Each mat weighs 85 lb., or about 0.81 lb.

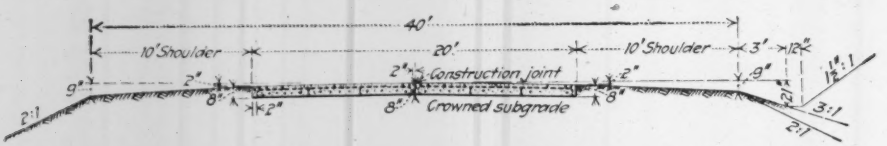



FIG. 1. TRANSVERSE SECTION OF MAT-REINFORCED-CONCRETE PAVEMENT

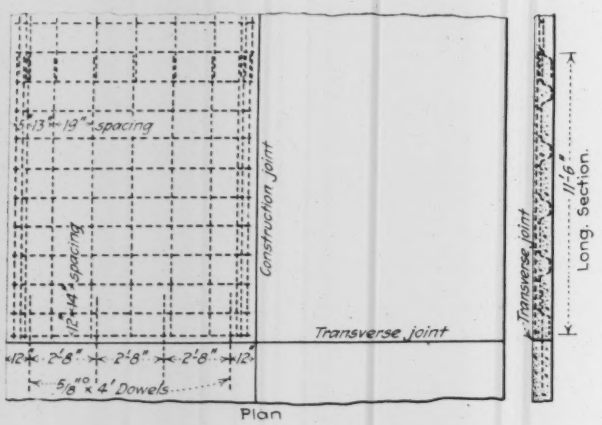



FIG. 2. DETAILS OF REINFORCING MATS

per square foot. Materials and construction are specified as follows:

Accuracy of bending is essential, therefore, only machine bent bars will be acceptable where bent bars are required. Hooks on the hook bars and bends on the trussed bars must be true and lie in the same plane.

All steel must be wired securely in bundles, each type by itself, in order to prevent damage in transit and facilitate its selection for construction.

This steel is then to be fabricated into units in an assembly frame, or by any other method meeting the approval of the engineer.

The units are to be tied together, at the points indicated on the plan, in the assembly frame by the use of bar ties. The ties must be made of spring steel wire, and have a powerful spring grip which will yield to permit the rotation of the bar, but will not loose their grip or permit either bar to slip under ordinary usage. Soft tying wire will not be permitted.

Reinforcing units shall be placed directly on the subgrade, lapping the longitudinal bars with those of the preceding section, and securely tied together as shown on the plan.

Concreting when commenced must be carried on continuously until the section is completed.

Where a transverse joint is made in the road at the end of a unit of reinforcement, an additional transverse reinforcing bar shall be tied to the longitudinal bars, one inch from the end of the unit.

A variation of ¼ in. over or under the specified length of bar will be permitted.

This road section was designed by the engineering department of the Delaware State Highway Department.

# Water-Works and Filtration Plant for Dairen, Manchuria

THE first rapid-sand filter plant in the Far East has recently been put in operation at Dairen, Manchuria, the Japanese name for Dalny. It was designed by the Pittsburgh Filter & Engineering Co., but erected by Dr. Kuratsuka without supervision or assistance other than the drawings, after he had made an extensive inspection trip to the United States and European cities. He describes the Dairen system and the filters in a recent article in *The Light of Manchuria*, from which the following notes are taken:

The city has grown from 18,872 in 1906 to 186,645 in 1920. The per capita consumption is based on 34 gal. daily for whites and Japanese and 7.5 gal. daily for Chinese.

The principal source of supply is the 1,300-m.g. Wangchiatien reservoir, 11⅛ miles northwest of the city and 7 miles from the Shahokou filter plant and pumping station. The dam is a gravity-section rubble-concrete arch structure 707 ft. long and 96 ft. high, abutting at both ends on solid rock. The width at the top is 11.5 ft. and at the bottom 67.4 ft. Because of the great variation in temperature, 30 deg. C. to 15 deg. below zero C., contraction joints were placed at intervals of 90 ft. The contact surfaces have a thin coat of asphalt and two copper strips are inserted across each joint along the longitudinal axis of the dam to cut off leakage. For 40.5 ft. down from the top, granite blocks 1.2 ft. square and 2.5 ft. thick are placed in the upstream face to provide against the freezing action of the water.

At Shahokou the Russians had sunk in the Malan River bed eight wells 20 ft. deep and 20 ft. in diameter. Only four were found in serviceable conditon by the Japanese. A blind dam 1,680 ft. long and 8 to 30 ft. deep had been constructed across the gravel river bed to intercept and raise the underground flow so that it would fill the wells.

On the way to the settling basin ahead of the filters water from all sources is aerated nine times. The principal aerator consists of 20-in. iron pipes, 39.5 ft. in height, standing erect in a well of elliptical shape, 42 ft. in major diameter and 12 ft. in minor diameter, built at the entrance to the settling reservoir, with a depth of 24 ft. The upper 17½ ft. of these two pipes stand out of the water. Three circular shaped thin flat blocks, made of reinforced concrete and ranging in diameter from 4 ft. to 6 ft., are fitted to the pipes at an interval of 5 ft. The uppermost block has ½-in. holes spaced 1 in. apart so as to break the water falling on the blocks from the mouth of the standpipes into many fine streams. In the minor aerating devices two thin perforated iron plates 4½ to 6 ft. in diameter are fitted to 10-in. pipes with the tops of the pipes 6 ft. above the water surface.

Originally there was built a slow-sand filter for the water collected in the wells. The rapid filters are mainly for the surface supply but the latter may be sent to the slow sand filters. A 5-m.g. plain settling basin was originally provided but one-third of it has been converted into a coagula-

tion basin of 6-hours detention period at the 3.6-m.g.d. nominal capacity of the filter plant. Four filter tanks 18 x 20 ft. in plan and 5½ ft. deep have 1,440 strainers with perforations aggregating 1/360 of the filter area. About 7 in. above the wash-water strainers is an air-grid system consisting of ¾-in. brass pipes spaced 6 in. c. to c., with ⅛-in. perforations on the under side 6 in. apart. The gravel support is 21 in. thick and the 0.35 to 0.50-m.m. sand is 30 in. thick.

Bacterial results per cubic centimeter of samples taken in March when the water was not muddy are reported as follows [presumably 20 deg. C. counts on agar.—EDITOR]: Plain sedimentation reservoir, 22; rapid filter effluent, 2; slow sand filter effluent, 4; service reservoir, 6. The low counts are attributed to the prolonged settling in the storage reservoir. Despite these results sterilizing appliances for the use of hypochlorite of lime have been installed for emergency use.

At present extensions are being made on a five-year program to cost $2,340,000 and be completed in 1924. They include a 3,840-m.g. storage reservoir on the Lungwangtang River, 18 miles west of Dairen, formed by a rubble-concrete dam, 121 ft. high and 1,048 ft. long, 14 ft. wide on top and 92 ft. at the bottom. For pumping power to lift the water over the divide that separates the new supply from the Malan River valley the electric station at Port Arthur is to be enlarged and a transmission line 10 miles long built. With the new supply completed a capacity of 6 m.g.d. will be available.

# Activated-Sludge Experiments at Moscow, Russia

## With an Appeal by Prof. C.-E.A. Winslow for Printed Material to Help Relieve the Intellectual Famine in Russia

BY S. STROGANOFF
Director, Laboratories of the Division of Sewerage of the City of Moscow, Russia

[*The appended letter and memorandum which has just been received by me seems worth printing in full as the first glimpse for five years of the progress of sanitary engineering in Russia. In accordance with Monsieur Stroganoff's pathetic appeal for relief of the "intellectual famine" from which the scientific men of Russia suffer, I beg that engineers and biologists having reports or reprints of articles dealing with recent studies of sewage disposal or stream pollution will forward them to me so I may make up a package to send to Monsieur Stroganoff.—C.-E. A. Winslow, Professor of Public Health, Yale School of Medicine, New Haven, Conn.*]

OUR visit to the sewage farms of Moscow with Mr. Whipple in the autumn of 1917 was for us the last manifestation of that scientific solidarity which knows no national or political limitations. Since then I have many times attempted to write to you but the letters always came back to me without crossing the frontier. During these four to five last years we have seen no journals and no scientific works. All my attempts to procure foreign literature through official channels have been in vain. Therefore there remains for me only this last attempt at re-establishing personal relations and your kindness in sending by Mr. Whipple your works on water bacteriology and sewage disposal gave me the hope that my effort will not be fruitless.

The principal investigations with which the bio-chemical laboratory of the division of sewerage of the city of Moscow was occupied under my direction between 1913 and 1919 were as follows:

1. Investigations on activated sludge and the process of aëration which have been conducted in the laboratory and in the experiment station which you visited. [A résumé of these investigations is printed further on.]

2. Biological investigations (1913-15) on the rivers Volga, Oka and Moscow with their tributaries in connection with the plan for obtaining drinking water for the city of Moscow in a quantity of 400,000 cubic meters.

3. Experiments on the purification of sewage through ponding (combined with fish culture) and on the self-purification of sewage without fish culture. Some of these last-named investigations are described in the annual report of the Commission on Sewage Purification.

At present we are studying the fermentation of sludge and are continuing our investigations on activated-sludge treatment. As to the latter I have no doubt of the success of this procedure in America but all my information stops with *Engineering News-Record* of 1917—and I beg you to pardon me if I hope to receive from you some information in regard to this problem.

I venture to draw your attention particularly to the formula $n \div \sqrt{v} =$ constant, which you will find in my report. Is it applicable to the aëration tanks of your country? You will note that this formula brings us back to the ideas of Col. Waring.

I should be greatly interested to hear of the results of the investigations by Professor Phelps on the self-purification of streams and on the conditions covering the discharge of sewage into such bodies of water.

America is bringing most generous aid to my suffering fatherland. Perhaps I may find across the ocean a friendly hand stretched out to assuage our intellectual famine and to give us the strength to continue our scientific work. S. STROGANOFF.

### RÉSUMÉ OF STUDIES ON THE PURIFICATION OF SEWAGE BY THE ACTIVATED-SLUDGE METHOD (MOSCOW, 1915-1919).

The experiments on the purification of sewage by aeration in the presence of activated sludge have been made by the department of sewers of the city of Moscow in 1915-1919, at the sewage farms under the direction of S. Stroganoff, chief of the bio-chemical laboratory. A detailed study conducted in the biological laboratory by Mlle. N. Basiakine was followed by technical investigations by M. T. Povartrine, engineer, at an experiment station which permitted the treatment of 7,000 cu.m. a day in the "aero tanks." The results of these studies may be summarized in the following paragraphs:

I. The purification of sewage by aeration in the presence of activated sludge is the logical technical development of the biological method.

II. The studies of this procedure conducted under different conditions in England and the United States as well as at Moscow for the sewage of that city in 1915 and 1919 permit us to draw a fairly definite conclusion in regard to the specific properties of the method. (1) Existence of two consecutive phases; (a) coagulation of colloids and (b) nitrification. (2) A close relation between the rapidity of purification $n$ (= the quantity of nitrogen oxidized in one hour in milligrams per liter) and the amount of air employed per volume of sewage per hour $v$. That is, $n \div \sqrt{v} =$ constant. This constant = 2.58 in our experiments (50 per cent volume of sludge, at a temperature of 15-20 deg. C. (3) Definite limits for the amount of

sludge necessary for the normal progress of purification. (4) Possibility of treatment by the activated-sludge method in winter ( — 25 deg. C.) on condition that the temperature of the sewage does not fall below 7 deg. C., the influence of the cold air being insignificant.

III. The two types of apparatus—aero tanks and aero filters—are distinguished from other methods of purification: (1) by the absence of offensive odors which permits their construction in the immediate vicinity of inhabited districts with consequent economy in outfall sewers; (2) by convenience in operation, since the process of purification depends entirely on the operator and permits the modification within the limits of the method of operating the purifying apparatus; (3) by the compact structure both as regards surface and volume since the apparatus (above all that of the aero filter) occupies a very small space (0.1 of that necessary for percolating filter). (4) by the cost of construction and operation, which for the city of Moscow will be inferior to that of other procedures in the case of aero filters as compared with biological beds following preliminary treatment for coagulation with activated sludge.

IV. The problem of treatment of sludge, of which the accumulation for Moscow amounts to 1 per cent by volume of the purified sewage, can be easily solved thanks to the absence of offensive odors, the facility of drying and thanks to its high fertilizing value.

V. All these qualities are in favor of this form of purification as a technical biological process independent of climate, easily operated, readily adapted to local conditions, and yielding an effluent purified to any desired condition. The adoption of this process in Russia under existing conditions meets with difficulties in regard to mechanical equipment (motors, compressors, piping) although the economy in materials and in labor are more favorable than in the case of other methods of purification (irrigation fields of bacteria beds).

For the moment we must continue under very unfavorable conditions the study of the nitrifying organisms (probably a group rather than a single form) that we have been able to isolate from the activated sludge as well as the study of the nitrification of ammoniacal solutions and of concentrated organic liquids (waste from tanneries and abattoirs and night soil).

## Demountable Body Motor Trucks in England

To facilitate store-door service in the handling of freight, and to reduce its cost under present conditions of labor and prices, the London & Southwestern Ry., England, has instituted an extensive service of motor trucks having movable or demountable floors. The ordinary motor truck was found to be uneconomical in view of the idle time while being loaded and unloaded. The removable floors are 13 x 6½ ft., each mounted on eight small wheels with ball bearings. For loading and unloading at the freighthouse these floors are placed on wagon frames which are moved by horses. The wagon frames and motor-truck frames have steel runway plates for the wheels of the demountable floors and have also suitable locks for holding these floors in position. In the morning the wagon frames with floors in position are placed at the freighthouse doors and as soon as they are loaded the horses move them to a parking place. A motor truck backs up to a wagon and the demountable floor with its load is rolled onto the truck and secured. When a motor truck returns empty or with an outbound load, its floor is at once transferred to a station wagon and the truck is ready for another trip. According to the *Railway Gazette* (London) the railway company's cartage service serves an area of 120 square miles and the haul averages four miles per ton. The average daily load per truck is about 11 tons, but some trucks have handled 20 tons in six trips. Trucks of 2- and 4-ton capacity are used.

# LETTERS TO THE EDITOR

***This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.***

## From the A. S. T. M. President

Sir—I notice on page 32 of the July 6 issue of *Engineering News-Record* that I am made to suggest, in addressing the American Society for Testing Materials, "that such agencies as the Federal Specification Board will be glad to have their work taken over by the society." As this statement is subject to misconstruction I have requested from Mr. Warwick a copy of the stenographic notes of what I actually stated, copy of which is enclosed.

GEORGE K. BURGESS,
Chief, Division of Metallurgy,
Bureau of Standards.

Washington, July 21

[The essential part of President Burgess' remarks as recorded by the stenographer is:

This society has a unique and predominant position on the subject of materials. There are three opportunities before us on this question. There is, first the American Engineering Standards Committee; we have a book of standards; very few of those standards have been put up to the American Engineering Standards Committee to be American Standards. I think in the coming year we should do more, very much more, in getting our standards revised and then adopted as American Standards. Second, there is the field of export use of standards, and there again we should concentrate more in making our standards available abroad. And third, the government does the largest business in the country and is the greatest buyer, and there has just been organized the Federal Specifications Board for the purpose of unifying standards and that board is not going to write standards when it can help it; therefore, this society, dealing with materials, has again a particular opportunity in making its standards of engineering and commercially used materials available for the use of the government."

Our report appears to have construed the statement that the specification board "is not going to write standards when it can help it; therefore this society has again a particular opportunity."—EDITOR.]

## The Other Side of the Case

Sir—I wish to thank you for your sane editorial of June 22 headed "Shingles Again Indicted." It is high time that the simple justice was done to shingles of calling for proofs to support the continuous attacks that have been so mysteriously made upon it during the last ten years. When we consider the long service rendered by the shingle and its great merits, we have also to consider whether propaganda of this sort should be permitted to drive out of use a building material of such varied and proven merit as the shingle.

In the first place the shingle is the best insulating roof covering that has ever been known, with the single exception of thatch. It covers the surface with three layers of wood, having good insulating properties. It is, therefore, many times more efficient in this respect than the saturated felt coverings, slate, tile, copper, tin or any other metal roofing. In these days of high cost of fuel this is a very important factor. The householder does not realize that a very large percentage of his furnace heat escapes through the roof. This is proved by the melting of snow on roofs during freezing weather.

The shingle is also the most aesthetic in appearance and capable of most artistic treatment of all the roof coverings. Its durability is such that it is more economical than most other coverings, and unless ordinances and laws prevent its use, would take the place of practically all of the cheaper manufactured substitutes.

No one advocates the use of inflammable building material in crowded cities, but the stories that are spread after every conflagration in which there are any wooden houses should not be accepted without the proof which you call for. This evidence is wholly ex-parte and is usually given by those interested in the propaganda. Statistics are quoted of the same general tenor as those so lightly given by R. S. Moulton in his letter to which you refer. In answer to similar figures, a statement was made before the Chicago Board of Aldermen a few years ago that if there were no frame buildings in Chicago the fire loss would be reduced only 3.84 per cent because all of the rest of the Chicago fire loss took place in wood, stone, steel or concrete buildings.

A number of years ago also, the *Lumber World Review* of Chicago quoted statistics of roof fires and showed that the number depended very largely upon the disposition of the statistician and his method of compiling his statistics. It is evident from the great variation in the figures quoted by Mr. Moulton that the same conditions probably apply in the cities referred to by him.

Fires are not only communicated to frame buildings in the way mentioned in your editorial, but also to other buildings because the collapse of the window panes from heat and the ignition of curtains, shades and other contents of the rooms is a very frequent occurrence.

SAMUEL CABOT, INC.,
March G. Bennett,
Boston, July 14. Gen. Mgr.

## Further Check of Formula by Field Test

Sir—The article, "Field Check on Formulas for Earth Pressure," by H. S. Schick in *Engineering News-Record*, June 15, 1922, p. 994, recalls to me an attempt made some ten years ago, to discuss the formulas used for pressure due to surcharge. At that time, the writer attacked the formulas by comparing the results obtained for sloping surcharge with those for uniform surcharge, to show the absurdity of the formula for sloping surcharge. The only reply was from Prof. Cain, resulting in a long private correspondence between the latter and the writer without arriving at any definite conclusion.

The method then proposed for figuring all surcharge, was to include the weight of the wedge inclosed by the "plane of rupture" and apply to this, the factor $\tan^2\frac{1}{2}(90-\Phi)$ to obtain the horizontal thrust resulting from the retained earth and its surcharge. While it is true that the angle of repose decreases with the increase in the height of fill, (or in fact with the addition of any surcharge), this factor could be cared for by the assumption of certain slopes at various heights of fill, which is actually practiced in the provisions for railway embankments. The writer was pleased therefore to note the article mentioned and to check his method against the figures actually obtained by field measurements, though the conditions are somewhat different.

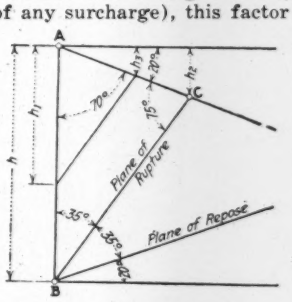


FIG. 1

Analyzing the problem in the article by this method, we have the following conditions: A wall of height $h$ subject to pressure of earth (saturated) weighing 122½ lb. per cubic foot and sloping down from the wall at an angle of 20 deg., surcharged with water to the level of the top of the wall.

We may assume that since the top of the earth slopes off at an angle of 20 deg. with the horizontal, the angle of repose of this saturated material is 20 deg., leaving the complement 70 deg., which divided by 2 gives 35 deg. as the angle made by the plane of rupture with the vertical. It would seem reasonable that at any point, as height $h_1$, the unit horizontal pressure $p_1$, would be the weight of the prism of earth plus that of the surcharging water modified by the $\tan^2\frac{1}{2}$ (90 deg.—20 deg.). But in addition to this, for a depth $h_2$, from the top to the intersection of the plane of rupture with the top slope, there is the horizontal pressure of the water itself which has to be added to the pressure as figured above.

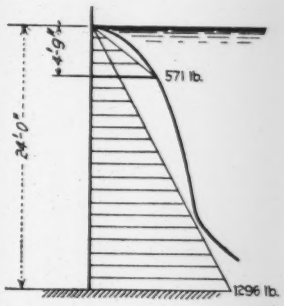


FIG. 2

The solution of the triangle in Fig. 1 results in the following formulas:

$$p_1 = [122.5(h_1 - h_2) + 62.5h_2]\tan^2 35 \text{ deg.}$$

$$h_2 = \frac{h_1 \sin 35 \text{ deg.} \sin 20 \text{ deg.}}{\sin 75 \text{ deg.}}$$

$$p_1 = \left[122.5h_1\left(1 - \frac{\sin 35 \text{ deg.} \sin 20 \text{ deg.}}{\sin 75 \text{ deg.}}\right) + 62.5h_1\frac{\sin 35 \text{ deg.} \sin 20 \text{ deg.}}{\sin 75 \text{ deg.}}\right]\tan^2 35 \text{ deg.}$$

this results in:

$$h_2 = 0.203h_1$$

$$p_1 = 54.0h_1$$

But down to a point at a height $h_x$ below the top, this pressure must be augmented by the horizontal pressure of the water resulting in formula:

$$P_x = 54.0h_x + 62.5h_x = 116.5h_x$$

For wall 24 ft. high as per problem, the height:

$h_2 = 0.203 \times 24 = 4.9$ ft.

$P_{4.9} = 116.5 \times 4.9 = 571$ lb. per square foot.

$P_{24} = 54 \times 24 = 1{,}296$ lb. per square foot at the bottom of the wall.

Using the curve in Mr. Schick's Fig. 3 and plotting these lines to the same scale, here reproduced in Fig. 2, we find rather a close agreement between the two, the variation being undoubtedly due to the action of the water horizontally below the line of intersection with the plane of rupture as there would be no abrupt ending of the horizontal water pressure but a gradual diminution and distribution through the earth resulting in a pressure line which would be a curve rather than a straight line.

As to the effect of drain pipes, there is no doubt that under all conditions these cause a reduction of the thrust by reducing the weight and increasing the angle of repose of the material retained. However in the case cited, so long as the water above the fill remained at a constant level there could be no reduction in thrust because the constancy of the water level would indicate a continuous supply of water equal to the drainage.

M. HIRSCHTHAL,
Concrete Engineer,
D. L. & W. R. R.
Hoboken, N. J.
June 21.

## "Tainter" not "Taintor"

Sir—Answering your editorial query in the issue of July 27, we can say that Jeremiah Burnham Tainter spelled his name with an "e" and not with an "o." Mr. Tainter was granted several United States patents on sector gates, notably those numbered 344,877-9, all dated July 6, 1886. His home was at Menomonee, Wis. He is not now living.

Fargo Engineering Co.,
By Wm. G. Fargo.
Jackson, Mich.,
Aug. 2, 1922.

# NEWS OF THE WEEK

New York, August 10, 1922

## Senate Committee Minority Favors Ford Offer

**Acceptance of Plan to Operate Muscle Shoals Property Urged on Senate**

In a report submitted Aug. 4 to the U. S. Senate, the Senate Committee on Agriculture submitted a minority report urging the acceptance of the offer of Henry Ford to operate the Muscle Shoals property, and strongly condemning the Norris plan, which contemplates government operation. This report follows the majority report, submitted to the Senate more than three weeks ago (see *Engineering News-Record* July 20, p. 120), which recommended the rejection of all bids so far submitted. The minority report was presented by Senator Ladd, Republican, of North Dakota, and signed by one other Northern Republican and by five Southern Democrats.

### Financing Proposal Stressed

Stress is laid in the report upon what the minority members believe to be economy in the cost of producing hydro-electric power, according to the Ford plan. It is pointed out that under the method of financing such projects about 80 per cent of the power as delivered at the switchboard is represented by interest on the investment. Such interest charge is to be eliminated, continues the report, by amortizing and returning the investment through a long-time sinking fund. Series of payments are to be provided which, when invested in a sinking fund at as low a rate of 4½ per cent, will return the cost of both dams as well as about $17,000,000 expended on them by the government. This feature, the report states, will allow the capital charge ultimately to be eliminated and power to be sold at approximate maintenance and operation cost, which in large plants runs between $1 and $3 per horsepower per year. The minority members of the committee believe that such a reduction of power cost is ample reason why the offer of Ford should be accepted.

Though the report admits the Ford plan has certain objections, it is stated they cannot be successfully met by government operation.

Other reasons why the Ford offer should be accepted, as stated in the report, included the statement that fertilizer costs would be materially reduced, a reduction not to be expected under present conditions of its manufacture; that the development promised by Ford would induce industrial expansion comparable to that resulting from the development of power at Niagara Falls; and that the utilization of hydro-electric power at Muscle Shoals would give the government an opportunity of seeing what was possible in the avoidance of fuel and transportation difficulties.

The report would contravene the provisions of the Federal Water Power Bill by acceding to 100-year lease.

### CHARLES WARREN HUNT HONORED BY NETHERLANDS ENGINEERS

**Dr. Charles Warren Hunt, secretary emeritus of the American Society of Civil Engineers, has been elected an honorary member of the Koninklijk Instituut van Ingenieurs of the Netherlands, the highest distinction within the gift of the Institute.**

**Dr. Hunt retired from active duty in January, 1920, after having served the Am. Soc. C. E. for twenty-eight years, three as assistant secretary and twenty-five as secretary. During the period of his incumbency the society grew in numbers and influence, its membership having increased from 1,800 to 9,400. He plans to attend in person the celebration of the seventy-fifth anniversary of the foundation of the Institute, which will be held at The Hague on September 8 and at which the diploma of his honorary membership will be presented to him.**

**An invitation to the Am. Soc. C. E. to have a representative attend the anniversary celebration has been accepted and Dr. Hunt will act also as official delegate from the Society.**

## Ferris Wheel Operator Released

The owner of the Ferris wheel which blew down at Clason Point Park, New York City, during the violent squall on June 11 (*Engineering News-Record*, June 15, 1922, p. 1014) was discharged last week from the charge of homicide which had been laid against him following the failure of the wheel. The magistrate held that there was no evidence of criminal responsibility and that the evidence showed that an extraordinary gale was responsible for the failure. A representative of the city building department testified that the wheel was of strong construction and had been regularly inspected. Six persons were killed in the failure and a dozen or more injured.

## Additional Road Bond Issues for North Carolina Possible

Plans for an additional road bond issue of from $10,000,000 to $25,000,000, supplementing the $50,000,000 bond issue authorized a year and a half ago, are being discussed in North Carolina. It is understood that all of the state highway commissioners have not definitely decided whether a new bond issue should be taken up at the coming meeting of the legislature or postponed until two years hence. The taxpayers, it is understood, have sufficient confidence in the state high way commission at the present time to insist upon completion of the state road system. That will mean an additional bond issue.

## Clear Road for Detroit Terminal of Pennsylvania R.R.

The dispute that temporarily blocked the Pennsylvania R.R. from entering Detroit has been ended by the abandonment for the present of plans for two additional tracks paralleling the Wabash and Père Marquette roads into the city. Construction of the Pennsylvania's $15,000,000 terminal will begin directly.

The Detroit City Council has passed an ordinance enabling the Pennsylvania-Detroit R.R. Co., an extension of the railroad lines of the Pennsylvania from Toledo to Detroit, to secure adequate facilities, and to use the Fort St. Union Depot located at Third St. and Fort St. West, jointly with other railroad companies. The ordinance also enables the railroad company to secure adequate and convenient freight terminals. The Fort St. Union Depot Co. is authorized to construct new or additional viaducts, to cross certain streets at grade and to close certain streets and alleys.

If permission should be obtained later to construct additional tracks crossing any thoroughfare at grade and the grades should later be separated, the entire construction cost of such grade separation within the limits of the intersections is to be borne by the railroad companies.

## Mayor of Seattle Removes City Engineer Dimock

A. H. Dimock, city engineer of Seattle, Wash., for the past eleven years and in the engineering department of the city for more than twenty years, has been removed from office by the recently-elected mayor who announced that the cost of several departments, including engineering, had become excessive, and that changes were necessary in the interests of economy. James DeRuyter Blackwell, who has been practicing privately in Seattle for several years, was appointed to succeed Mr. Dimock. When the mayor announced his plan he gave Mr. Dimock an hour in which to resign, but Mr. Dimock's resignation was not forthcoming so he was removed.

Mr. Blackwell was born in Virginia in 1870. His early engineering experience was in the city engineer's office of Nashua, N. H., and his time was devoted chiefly to street work. For nine years he was assistant engineer in charge of the Boston office of the Boston and Albany R.R., and in that capacity directed extensive grade-separation projects. In 1899 he went to Seattle and became identified with Stone and Webster during the laying out of the Seattle street-railway system. For three years he was chief engineer of the Seattle Electric Co. and in 1903 became superintendent for the Puget Sound Bridge and Dredging Co.

In 1905 he formed a partnership with H. D. Handford and opened an office in Seattle for the practice of general engineering.

## Contractors Protest Priority Order of I. C. C.

That the greater part of the construction projects now under way will be forced to shut down for lack of construction materials unless the present coal priority order is modified is the statement made Aug. 7 by the Associated General Contractors of America in a petition of protest to the Interstate Commerce Commission. It is the opinion of the contractors that the action of the Commission is so drastic as to defeat its own purpose to keep industry in operation by practically shutting down the second largest industry in the country employing 11,000,000 people.

The contractors are in favor of priority for coal for the first four classes established by the Commission, including special purposes, government uses, public utilities, medical supplies, and domestic consumption; but contend that building materials are just as important to construction as coal is to other manufacturers, and should have equal place with it after the first four classes are served.

The petition calls attention to the fact that with the reopening of the mines the demand for cars for coal will be not less than 320,444 cars per week, of the maximum 324,000 serviceable cars of these only 291,000 will be suitable for the loading and transportation of coal, leaving only 33,000 open-top cars weekly for all other purposes. Contractors estimate that during August, September, and October (granting the strikes will be settled and the priority order will stand) 50,000 open top-cars will be demanded per week for transportation of sand, stone and gravel, whereas the supply could not be much over 10,000 cars.

## Lumbermen Appoint Committee on Standardization Rules

A committee to formulate specific recommendations as to standardization of sizes, grades, inspections and guarantees for submission at the next general standardization conference to be called by Secretary Hoover has been appointed by the National Lumber Manufacturers Association at a meeting recently held in Chicago. This meeting considered the findings of a special committee that met at Madison, Wis. and prepared an outline for the development of grading regulations.

As data were not available with respect to hard-wood grading the Chicago conference considered only the softwoods. The newly-appointed committee, which is empowered to increase its own membership as occasion may require, consists of the following: John W. Blodgett (chairman), president of the National Lumber Manufacturers Association, Grand Rapids, Mich.; John H. Kirby, Houston, Texas; Chas. A. Goodman, Marinette, Wis.; J. E. Lloyd, National Retail Lumber Dealers Association, Philadelphia, Pa.; Dwight Hinckley, American Wholesale Lumbermens Association, Cincinnati, Ohio; two representatives of consumers—one to be selected by the American Railway Association and other by the American Institute of Architects.

## Improvement in Engineering Employment Continues

For several months there has been a gradual and steady advance in engineering employment in all sections of the country, with increased activity in many basic industries, according to the employment bureau of the American Association of Engineers. The building industry has been most active, with some irregularities in the manufacturing line, although a gradual improvement in manufacturing and industrial work is evidenced. The coal mining and railroad fields show a slight setback, due to labor difficulties, although technical men are in demand.

Highway and municipal work are progressing with added vigor, and employers in these fields find it difficult to locate experienced men. The demand for architecural and structural draftsmen and designers with building or plant experience has far exceeded the supply in practically all sections of the country. From ten to twenty such positions are received daily at national headquarters and chapter employment offices, but few experienced men are available. Employers are informed of conditions and usually they are required to advertise in the daily newspapers or technical journals for the men desired.

The total number of positions received by the association, including those at national headquarters and by employment representatives, is 402 for May and 433 for June against 351 for June, 1921. Corresponding figures of men placed are 249 for May, 225 for June and 195 for June, 1921. The total number of men registered for employment during June was 1,456. In May 1,443 applied and in June a year ago 1,960 were after jobs. The great majority who are registered for employment desire to improve their conditions or change to other localities. This record in employment work far exceeds any that has been accomplished by the association since its organization. The average monthly salary of all positions during June was $192.

## British Railway Electrification Plans Well in Hand

*London Correspondence*

The British railway companies are forging ahead with their plans for the electrification of their suburban lines. The South-Eastern and Chatham, which serves a greater part of the London suburbs lying south of the Thames, has its plans completed and is ready to begin work. This company will electrify some 220 miles of suburban line at an estimated cost of £6,500,000. The work will occupy about three years and will give employment to 6,000 to 7,000 men. The only difficulty still in the way is to obtain the consent of the electricity commissioners for the erection of a power station.

Electric trains have already started running on the London and North-Western Ry. In 1907 this company obtained parliamentary powers to electrify certain sections of their lines and this work has now been completed. The company will now proceed with electrification under the present scheme. With the introduction of these electric trains there will be twelve trains per hour in each direction on the chief suburban lines.

## Priority Order's Effect on Road Work

The following replies to *Engineering News-Record's* query regarding the effect on road work of Interstate Commerce Commission car-priority orders were received too late to be included among those published in last week's issue:

**Ohio**—To date we have noticed practically no effect of the Interstate Commerce Commission priority order. It is to be expected, of course, that if the priority order is enforced as at present outlined, it will of necessity curtail our construction to the extent that we will not be able to complete our program. We have under construction approximately 900 miles. I do not feel warranted, however, under the unsettled conditions to make any predictions as to the outcome.—*Leon C. Herrick, director, Department of Highways and Public Works.*

**Minnesota**—Present indications are that the Commerce Commission priority order will not seriously affect Minnesota road constructions. Paving contracts are well advanced and materials are in storage, but it is possible that several important connections may not be completed on account of lack of cement; this is evidently due to the coal situation rather than to priority orders. —*John H. Mullen, state highway engineer.*

**North Carolina**—Fortunately an extensive material survey during the fall of 1921 and the finding of large quantities and subsequent use of local material on a large part of the 1,600 miles of road now under construction in North Carolina makes it possible for road building to proceed, although at a reduced speed. With a single exception the cement situation is satisfactory but already a large mileage of the asphalt and concrete construction is suspended for lack of crushed stone.

The priority order that went into effect July 26 is beginning to be felt in earnest and the larger proportion of the road construction which is supplied by rail transportation is curtailed and the only hard-surface work now going on unhampered is that on which local aggregates are used. Roughly speaking about one-half of the mileage of hard-surface roads is being supplied by local materials. Approximately 50 per cent of the entire mileage is made up of sand-clay-topsoil gravel or macadam, and with 25 per cent of the concrete and asphalt work being supplied by local materials this leaves about 400 miles of hard surface that is affected by the car situation and priority order. Coal shortage has affected the progress of only one contract up to date.

Although these conditions show the serious situation of about 50 per cent of the hard-surface work being delayed it really means that about 25 per cent of the entire program is affected.

Contractors are at present holding their organizations; putting them in such work as grading and other minor operations so that as soon as the car situation is cleared the contractor will have an organization to place at work immediately to endeavor to overcome the present handicap of the priority order and car situation.—*C. M. Upham, state highway engineer.*

## Allocate River and Harbor Funds

*Washington Correspondence*

During the current fiscal year the Corps of Engineers will expend $5,000,000 on the construction of locks and dams on the Ohio River; $3,000,000 on the Delaware River between Philadelphia and the sea; $2,500,000 for the inland waterway between the Delaware River and Chesapeake Bay; $2,000,000 on the East River, N. Y.; and $2,000,000 on the Southwest Pass of the Mississippi River.

Other projects, to each of which have been allocated more than $500,000 from the river and harbor appropriation are as follows: Mississippi River between the Missouri and Minneapolis, $1,000,000; Detroit River, $1,000,000; Mississippi River between the Ohio and Missouri Rivers, $915,000; Savannah Harbor, $900,000; Columbia and Lower Willamette Rivers below Vancouver, Wash. and Portland, Ore., $850,000; ship channel, Houston, Texas, $750,000; South Pass, Mississippi River, $600,000; St. Marys River, Mich., $557,000; Los Angeles harbor, $500,000; Buffalo harbor, $500,000.

## New York State to Have Standard Building Code

Following the failures of the American Theater in Brooklyn and the Knickerbocker Theater in Washington last year, the legislature of the State of New York passed an act creating a committee of 24 to formulate a state standard building code under the direction of the State Industrial Board. Pursuant to this act Commissioner Henry D. Sayer of the board has appointed a committee which will formulate the rules to be presented to the board for approval. The membership of the committee comprises five labor men, one health department man, one policeman, one mayor, five theatrical men, one hotel man, two insurance men, five city building department officials, two architects, and an illuminating engineer.

## Spruce Production Railroad on Olympic Peninsula Sold

The sale of the railroad built by the Spruce Production Division of the Aviation Service on the Olympic peninsula in Washington has recently been announced by the War Department. The purchasers, who will operate the road as a common carrier, are given as F. S. Scritsmier, Portland; Fentress Hill, San Francisco, and J. K. Lyon, Los Angeles. The sale price is given as $1,000,000. The properties include 36 miles of standard-gage railroad extending from Disque, the terminus of the Chicago, Milwaukee & St. Paul R. R. to Lake Pleasant; railroad rolling stock, a sawmill, logging and miscellaneous equipment. No timber is included.

The mill is located one mile from Port Angeles on Puget Sound and was designed for a capacity of 400,000 ft. b.m. per eight hour shift. The railroad taps 6,500,000,000 ft. b.m. of timber on an area of about 300 square miles and is capable of extension to tap still larger timber stands. The new owners are reported to be forming a company to operate the railroad and sawmill.

## *The Engineer in Public Life*

### GEORGE C. MASON

For five years George C. Mason of the Hurley-Mason Co., designers and builders, Portland, Ore., has served as a member of that city's Civil Service Commission. His other public activities have included the state chairmanship, during the war, of the associate members of the Naval Consulting Board. Mr. Mason was born in New York City in 1871, and was graduated from New York University with the degree of B.S. in 1892, subsequently receiving from that institution the degrees of C.E. and M.S. After a period as assistant professor in civil engineering at New York University and as engineer on surveys in New York State, he assumed charge, for Frank Jay Gould of the erection of the Gould residence in New York. Since 1904 he has been vice-president and chief engineer of the Hurley-Mason Co. and among the structures his firm has built are some of the principal public and private buildings in Portland, such as the Carlton Hotel, North Pacific Dental College, Homeopathic Hospital, and the Board of Trade Building. His company also constructed the army cantonments at Camp Lewis and the Todd Dry Dock and Shipbuilding Co.'s plant at Tacoma.

As a member of the Civil Service Commission of Portland, Mr. Mason has endeavored to impress upon city employees that they have no mortgage on a life job, but that, on the contrary, unless they render service for salary received the appointing authority may remove them, and the civil service board will sustain the removal. "We are," he says, "anxious to protect the employee against removal because of political or religious reasons, but where it is for the good of the service and without personal prejudice, we have invariably sustained any discharge."

## A.A.E. to Investigate Vocational Selection for Engineers

The American Association of Engineers is about to undertake an investigation of engineering training and employment. Engineering positions will be analyzed to ascertain the qualifications required and to determine which of them engineers should be expected to obtain in early training and which through practical experience. It is believed that work of this sort will help to fit men into positions in which they can serve most effectively.

The committee which has been appointed to take up the work is assured of the co-operation of Dr. C. R. Mann, who investigated the subject of engineering education for the Carnegie Foundation, and who has had much intimate contact with practical applications of vocational selection.

## International Road Congress to Meet in Seville in 1923

Final arrangements have been made for holding the fourth International Road Congress in Seville, Spain, early in May, 1923. An elaborate program has been prepared covering all phases of highway engineering and transport and many Americans either directly or indirectly concerned with these subjects are to contribute to the program.

The first section of the program will concern itself with construction and maintenance. Separate discussions under this general heading will have to do with surfacing roads with concrete in which all the details of materials, plant, proportions, use of expansion joints, advantages and disadvantages of the pavement type, and the results obtained under various circumstances will be thoroughly gone into. Bituminous and asphaltic surfaces will comprise the second question under construction and maintenance and the various methods at present in use will be fully discussed.

The question of laying street-railway rails on the various types of road surfaces will also have special attention and particular discussion will be had of the advantages and disadvantages of various types of roads when laid with rails, the connection between the rail and the surface and the need for lessening noise and vibration.

The second section of the congress will be devoted to traffic and development. Desiderata for improving design and construction of roads in order to meet the tremendous development of motor transport will be the first to be taken up. General traffic regulations including weight and speed, tire widths, lighting, drivers' licenses, the rights of pedestrians and animals, passing and overtaking and other questions will be discussed as well as the problem of handling traffic on congested roads and streets of towns. In this last discussion consideration will be given feasibility of separating slow and fast traffic as a means to solving traffic problems.

Under the general head of construction and maintenance special attention will be given to the progress made in the application of modern mechanical appliances to construction and maintenance of highways. This discussion will include any supplementary information on mechanical equipment introduced since the last congress which was held in London in 1913.

## Engineers Sue as Result of Alleged Libel

A. M. Lund and P. B. Hill, engineers of Little Rock, Ark., have entered damage suits against H. L. Remmel, state republican chairman for Arkansas, demanding $50,000 for alleged libelous statements. The suit charges Remmel with falsely stating that Messrs. Lund and Hill wasted the taxpayers' money in connection with the Little Rock-Hot Springs highway construction. The libel is alleged to have been made in an article written by Mr. Remmel and published in the Little Rock *Democrat*. The members of the Arkansas Chapter of the American Association of Engineers are giving the engineers moral support in their suit in the endeavor to end what is characterized as "a too free habit among more or less prominent citizens to attack engineers publicly without cause."

## New Canadian Laws Place Severe Limits on Truck Weights

Two new laws have been passed that will affect the use of motor trucks in the province of Quebec. The provincial government has prohibited any truck of over 2½ tons weight to use the provincial highways outside of cities. Although owners of the large trucks are subject to a provincial tax the trucks are not allowed on the roads of the province outside the city streets. Power has been vested in the city to regulate the size of the loads carried by these heavy trucks.

The city of Montreal has enacted a by-law under which 5-ton trucks will be limited to loads of 3 tons if equipped with pneumatic tires; trucks without pneumatic tires are prohibited from transporting loads of over 2½ tons.

There are many firms in the city of Montreal, including large construction companies which own heavy motor trucks. Some of the construction companies are considering the elimination of the trucks of over the 2½ tons capacity. It is claimed that if the law is not repealed, it will not be profitable to use the 5 ton trucks when carrying only half the loads they formerly transported.

The reason for the provincial law and the city law is the same, namely, the fear that the heavy trucks will damage the streets and highways with the heavy loads.

In the province of Quebec the sale of heavy trucks has been injured greatly by the two new laws. Some of the owners of the big trucks have already offered them for sale on the eve of the operation of the two laws. Some of the contracting companies are purchasing draught horses in Prince Edward Island and New Brunswick for use instead of the big trucks in transporting building materials.

## To Hold Safety Congress

The annual Safety Congress and exhibition of safety appliances of the National Safety Council will be held at Detroit, Aug. 28 to Sept. 1. As usual, a long program of papers and demonstrations has been planned. Each of the 21 sections of the council will meet separately in two or three sessions and there will be a number of general sessions at which topics of interest to all sections will be discussed. The topics listed for the civil engineering construction section are: An address by Gen. R. C. Marshall, representing the Associated General Contractors; practical safety methods for field superintendents; keeping accident records; safety work on high steel buildings; industrial surgeons, and elimination of waste in construction.

## Garbage Collectors' Strike Fails at Detroit

On account of a reduction in wages from $5.50 to $5 a day, garbage collectors and drivers at Detroit, Mich., struck recently. Joseph A. Martin, commissioner of public works, informs *Engineering News-Record* that little difficulty was experienced in replacing the strikers and that there were only a few attacks on the men and those minor. On Aug. 4, strikers were applying for positions but were not being taken back.

## State Not Forced to Repair Road Intersections With Town Streets

An opinion by Attorney-General U. S. Lesh, of Indiana, recently given to the State Highway Commission holds that the commission is not required by law to repair and maintain streets in incorporated towns where the streets connect state highways. The commission has discretionary powers in regard to making these improvements, the opinion holds. In some towns and cities of Indiana, streets connecting state highways have been allowed to fall into bad condition by the local officials on the ground that the repair work should be done by the state highway commission.

## Record Shipment of Electrical Plant for Chilean Railways

Two trainloads of equipment for the electrification of the Chilean State Rys. have left Pittsburgh, in partial fulfillment of the contract between the Chilean Government and the Westinghouse Electric International Co. for the $7,000,000 worth of apparatus included in the initial installation.

The second shipment, one of the largest single consignments on record of electrical apparatus for railroad electrification, was attended by considerable ceremony and the train was set in motion by radio control. Equipment already shipped includes all the apparatus for the five sub-stations contemplated under the present project.

## Zoning and Major Street Plan Work at Columbus, Ohio

Preparation of zoning and major street plans for Columbus, Ohio, has been started by the City Planning Commission. A. H. C. Shaw, who was connected with the work of the Cleveland City Planning Commission for several years, has been employed as engineer of the Columbus Commission and Robert Whitten, city planner, of Cleveland, has been retained as consultant to the commission. Prof. F. H. Eno, of the department of engineering of Ohio State University, is a member of the Columbus City Planning Commission and chairman of its committee on zoning and major street plan.

## Industrial Executives to Meet

The seventh annual summer session in industrial organization and administration will be held at the Pennsylvania State College, Aug. 28-Sept. 9. The session will be under the immediate direction of Prof. Edward J. Kunze, assisted by Prof. J. O. Keller and Prof. P. P. Henshall of the department of industrial engineering. The course is designed to meet the needs of manufacturers, superintendents, personnel directors, accountants, production managers, and others.

The purpose of the conference is to assist men in the development of their jobs, to broaden the applicability of scientific methods to industrial management, and to illustrate the most effective methods of modern organizations. The work is divided into discussions on industrial organization, manufacturing methods, employment, industrial relations, factory planning, material and production control, scheduling and dispatching, purchasing, cost accounting, and kindred subjects.

## To Award Highway Fellowships at Michigan

Two of the following fellowships will be awarded not later than Sept. 1 and two not later than Nov. 1, by the Board of Regents of the University of Michigan:

The Roy D. Chapin Fellowship in Highway Transport, for the investigation of an approved subject relative to highway transport.

The Roy D. Chapin Fellowship in Highway Engineering, for the investigation of an approved subject relative to hard-surfaced roads and pavements.

Two Detroit Edison Fellowships in Highway Engineering, for the investigation of approved subjects relative to moderate-cost country roads.

Each fellowship pays the sum of $250 with an allowance of $50 for expenses. The holders of these fellowships do not have to pay tuition fees. A fellow must hold a bachelor's degree from a college of recognized standing. An application for a fellowship must include a concise statement of the candidate's educational training and engineering experience, and three references. Requests for information should be sent to Prof. Arthur H. Blanchard, University of Michigan, Ann Arbor, Mich.

## Foreign Light-Railway Society Meets in October

The newly-organized International Tramways, Light Railways and Bus Transport Association, with headquarters at Brussels, Belgium, will hold its first annual meeting at Brussels in October. This association is the successor to the old established Tramways and Light Railways Association which was dissolved at the time of the World War by order of the Belgian government because its membership included German companies. The property of the association was also sequestrated since it consisted in part of enemy funds.

Membership in the new association is limited to companies in the allied and neutral countries, and includes also officers of these companies and associate members who are interested in the question of local transportation but are not officially connected with the industry. The president is C. de Burlet, director of the National District Railway Society (Belgium); the secretary is Henri Camp.

## Civil Service Examinations

### UNITED STATES

*For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.*

Vacancies in the Income Tax Unit of the Bureau of Internal Revenue, Treasury Department. Appraisal engineer, $3,000 to $4,000 per year. Receipt of applications to close Aug. 29.

Vacancies in the Lighthouse Service. Architectural and structural steel draftsman, $1,380 and $1,800 per year. Receipt of applications to close Sept. 6.

Vacancies in the Bureau of Public Roads. Highway research specialist: Grade 1, $1,800 to $3,000 per year, or $6 to $10 per day; Grade 2, $3,000 to $4,500 per year, or $10 to $12.50 per day. Receipt of applications to close Sept. 12.

## ENGINEERING SOCIETIES

### Calendar

**Annual Meetings**

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

**The County Engineers' Association of California** has elected the following officers: R. R. Arnold, Martinez, president; J. L. McBride, Orange County, vice-president; Lloyd Bowman, Santa Cruz, secretary-treasurer; E. P. Bell, Napa, and Howard F. Coussens, Salinas, directors.

**The San Diego (Cal.) Chapter, American Association of Engineers,** has elected officers as follows: President, F. S. Callender, naval public works office; vice-president, A. C. Black; secretary, C. B. Ireland; treasurer, R. W. Miller; delegate to state association, N. W. Cummings.

**The Illuminating Engineering Society** is to hold its 16th annual convention at Swampscott, Mass., Sept. 25-28. Charles L. Edgar, president of the Edison Electric Illuminating Co., Boston, is chairman of the general convention committee.

## PERSONAL NOTES

SQUIRE E. FITCH, Westfield, N. J., has been appointed county engineer of Chatauqua County, N. Y. He succeeds WILLIAM J. KNAUER, of Jamestown, N. Y., who has resigned.

A. V. RUGGLES, until recently engineer of construction and surveys in the Cleveland water department, in charge of the design and construction of the Baldwin-Fairmount project, involving the expenditure of about $13,000,000, recently was appointed water commissioner for the City of Cleveland. Several years ago Mr. Ruggles was with Hazen & Whipple, consulting engineers, New York City, on various filtration-plant projects. Later he became assistant engineer for the Board of Water Supply of the City of New York. After spending some time on work in connection with the Catskill Aqueduct, New York City, Mr. Ruggles in 1914 became assistant engineer of the Division of Water, Department of Public Utilities, of Cleveland, a position he held until August, 1917. During the war Mr. Ruggles was a captain of engineers and most of his oversea's service was as an assistant to Major John B. Hawley, in charge of water supply and sanitation in Base Section 1, A. E. F.

JAMES A. DAVIS, chief engineer of the Washington State Highway Division for the past nine years, has resigned, to enter the employ of the Carlson Construction Co., of Spokane. GEORGE T. MCCOY, present assistant chief engineer, will succeed Mr. Davis.

R. M. TAYLOR, who has been with the H. W. Kaylor Construction Co., Elkins, W. Va., has joined the engineering staff of the West Virginia State Road Commission as assistant engineer of construction.

WALTER S. PEDERSEN, until recently designer for the Iowa Steel & Iron Works, has been made chief engineer of Geiger and Peters, steel fabricators, Indianapolis, Ind.

J. C. BURGESEN, former assistant engineer with the Union Pacific R. R. Co., has been made project engineer for the Missouri State Highway Department.

WALTER MOORE, JR., has resigned as manager of the Southern California Chapter, Associated General Contractors of America, to accept the sales management of the Union Rock Co., Los Angeles. E. EARL GLASS, engineer for the chapter, is now manager.

M. A. GOULD, assistant engineer with the Illinois Division of Highways for the past few years, has been appointed instructor in the civil engineering department of the University of Idaho. Mr. Gould is a graduate of the University of Illinois and spent two years with the U. S. Signal Corps.

IRWIN S. OSBORN, of Allen & Osborn, consulting engineers, Cleveland, Ohio, has joined the engineering and executive staff of the C. O. Bartlett & Snow Co. of Cleveland. The company named is to add service in the refuse incineration field to what it has already been rendering for many years in garbage reduction.

HORACE P. RAMEY, division engineer, Sanitary District of Chicago, and in the service of the district since his graduation from the University of Michigan 15 years ago, has been made acting chief engineer, during a temporary leave of absence of ALBERT W. DILLING, chief engineer.

W. D. WILSON, of Englewood, N. J., has recently been appointed superintendent of the public works department of Rockville, Conn., succeeding CLAYTON E. SWAIN, resigned.

EZRA C. SHOECRAFT, for the past nine years city engineer of Flint, Mich., has joined the sanitary engineering firm of Hoad, Decker & Drury. City paving and other municipal work will be handled. The name of the new firm will be known as Hoad, Decker, Shoecraft & Drury.

HENRY HOLGATE, of Montreal, Que., has been retained by the Dominion Department of Railways & Canals to report on the hydro-electric power in the Trent Valley District, with a view to settlement of differences between the Ontario Hydro Electric Commission and the Federal Department of Railways and Canals.

C. E. GHYSENS, city engineer of Verdun, Que., has resigned. He is succeeded by H. HADLEY, former city engineer.

EDWARD H. SPIERS, former assistant field engineer with the Interstate Commerce Commission, Bureau of Valuation, is now resident engineer with headquarters at Elkin for the North Carolina State Highway Commission.

CHARLES CLARAHAN, JR., is now junior engineer with the Division of Highways, State of Illinois. He was formerly structural engineer for N. B. Garver, consulting engineer, Little Rock, Ark.

LIEUT.-COMMANDER E. D. STANLEY, Supply Corps, U. S. Navy, attached to the office of the chief co-ordinator, will soon spend some time in Albany, N. Y., in connection with the organization of a centralized purchasing office recently authorized by the New York legislature. Endeavor will be made to co-ordinate the purchase and storage activities of New York State with similar federal activities within the state.

## OBITUARY

A. L. JOHNSON, president of the Corrugated Bar Co., Buffalo, died at his home in that city July 21. An extended obituary will appear in a later issue of this journal.

TIMOTHY SHEA, retired railroad contractor of Knoxville, Tenn., who has made his home in Washington, D. C., for several years, died recently at the age of 73 years. Mr. Shea was one of the most prominent railroad contractors of the south, besides having done much work throughout the southern section of the United States had executed a large number of contracts for the republic Guatemala.

FRANK E. BOGARDUS for seventeen years county engineer and superintendent of highways for Onondaga County, New York, died recently at East Syracuse, aged 56 years. Previous to his becoming superintendent of highways of Onondaga County he had served as superintendent of highways for the town of DeWitt. He was the treasurer of the County Superintendent of Highways Association for a number of years.

A. L. HARRIS, consulting engineer of Los Angeles and Phoenix, Ariz., died recently in the former city, aged 50 years. Outstanding in his professional practice were his associations with reclamation and irrigation projects. For seven years he was an assistant engineer in the U. S. Reclamation Service, spending most of that time in or near the Roosevelt Dam. He was graduated from the University of Michigan in 1896 and after graduation was employed successively by the New York State Barge Canal Survey, the Isthmian Canal Commission, the Pennsylvania & Long Island R. R. companies and private firms in drafting, designing and estimating. Mr. Harris was chief engineer of the Pari-

dise-Verde project and was connected also with the Beardsley and Lotus Valley Project in a consulting capacity. He was a member of the American Society of Civil Engineers.

# BUSINESS NOTES

MONROE L. PATZIG has been appointed representative of the Conveyors Corporation of America, Chicago, for the sale of the American trolley carrier in the Des Moines, Iowa, district.

F. L. HOWELL & CO., drilling contractors, have removed their offices from Scranton to Pittston, Pa.

THE C. O. BARTLETT & SNOW CO., of Cleveland, Ohio, announces that hereafter it will build refuse destructors as well as garbage reduction plants and that it has added to its engineering and executive staff Irwin S. Osborn, consulting engineer, who has specialized for years in garbage and refuse disposal. Associated with Mr. Osborn in directing the enlarged service of the company will be Mr. Bighouse, who has long been in charge of the garbage disposal work of the company. Raymond Wells will also continue with the company as consulting chemical engineer.

# EQUIPMENT AND MATERIALS

## Truck for Road-Building Service

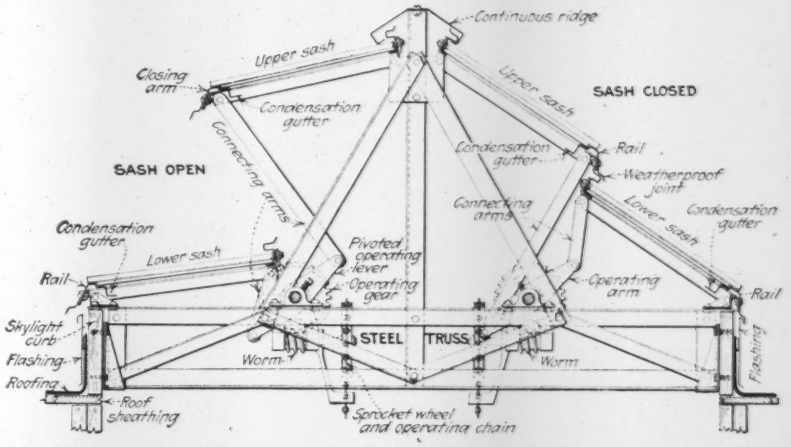
Designed especially for road-building service, a motor truck with a short wheelbase and equipped with 1 and 2-cu.yd batch bodies has been developed by the Republic Truck Sales Corp., Alma, Mich. To provide manoeuvering ability on subgrades the truck is equipped with pneumatic tires and with a wheelbase of only 110 in. The turning radius is 15½ ft. A special low gear ratio enables the truck to negotiate sand and mud roads. The body is mounted low and is balanced over the rear axle. Approximately 40 per cent of the total load is carried on the front wheels.

Three body designs, all of 2-cu.yd. capacity, are available. The standard rear discharge type, with two compartments, is fitted with an underbody hydraulic hoist and a swinging center partition controlled by the driver. This type of truck is intended for use at a central proportioning plant. For the wet-mix system the truck body comprises two gravity end-dump hoppers. A third body action provides for mounting two batch boxes of 1-cu.yd. capacity so that contractors may use existing equipment if preferred.

## Balanced Ventilating Skylight

Steel-frame skylights having pivoted sash counterbalanced for easy operation and giving an exceptionally large unobstructed area when fully open form a recent development for industrial buildings in which fumes, steam or gases make ample ventilation essential. They are the invention of B. P. Blaski and are being introduced by MCKEOWN BROS., INC., of Chicago and New York.

From the drawing of the double-pitch skylight it will be seen that each face consists of two panels. The distinctive feature is that these two panels are hinged at top and bottom respectively and are so connected as to balance each other. When closed a weatherproof joint is formed. Interior condensation is collected by gutters on the sash. A rocking lever mounted on the skylight frame carries two connecting arms whose outer ends are pivoted to the two sash panels so that as one panel moves up the other moves down and the panels are thus counterbalanced. On the lever shaft is a worm wheel engaging a worm which is operated by a sprocket wheel and endless chain. In this way the panels can be moved readily to give any desired extent of opening and they will remain in position since they cannot overhaul the worm gear.




These skylights are made in four standard widths of 6 to 12 ft. and of any desired length, with all the sash movable or with alternate sections of fixed and movable sash. They are shipped knocked down ready for erection and simple instructions enable any handy man to install them on existing buildings. For sawtooth roofs a somewhat different construction is used.

## Out-of-the-Ordinary Trade Publications

*Segment Block Sewers*—THE AMERICAN VITRIFIED PRODUCTS CO., Akron, Ohio, has issued a hand-book of information on Amco segment block sewers. The material is presented in seven chapters dealing with manufacture, tests, design, construction, estimating and specifications. The blocks, of vitrified clay, are adapted both to circular and egg-shaped sewer sections. There are a number of tables devoted to sewer hydraulics, excavation quantities per linear foot of trench, areas of circles, number of brick required, etc. The data and illustrations are in convenient form for the use of municipal and consulting engineers.

*Dragline Cableway Excavators*—SAUERMAN BROS., Chicago, have published an 18-page illustrated pamphlet on handling sand and gravel with dragline cableway excavators which dig, elevate, convey and dump material without the use of intermediate machinery. The scraper buckets are made in six sizes, from ¾ to 2 cu.yd., and the maximum economical cable span is 800 ft. Photographs and text cover a wide variety of installations of this type.

*Lime*—THE OHIO HYDRATE & SUPPLY CO., Woodville, Ohio, presents facts about the origin, manufacture and use of lime in a 16-page illustrated booklet.

*Asphalt Macadam*—THE TEXAS CO., New York, has revised and reprinted its 12-page booklet entitled "How to Build an Asphalt Macadam Road." Steps in constructing the base and the wearing surface are described and a number of photos illustrate methods of applying the asphaltic binder by hand pouring and pressure distributors.

*Pit and Quarry Equipment*—THE WESTERN WHEELED SCRAPER CO. shows the adaptability of its equipment to pit and quarry work in a 16-page booklet profusely illustrated with photographs of its scrapers, dump cars, elevating graders, dump wagons and carts, road and railroad plows, jaw crushers and gravel-screening plants. The text deals with operating methods at specific installations.

*Riveted Steel Pipe*—THE MERCHANT SHIP BUILDING CORP., Chester, Pa., describes in an 8-p. illustrated folder the process of manufacture of large-diameter riveted steel pipe. The views, with brief descriptive text, cover the following steps: Pickling, punching, planing, scarphing, rolling, and plant layout for the fabrication of large diameter steel pipe (7½ to 8½ ft.) for use on the Catskill aqueduct, New York. There are also illustrations of radio and transmission towers and grain elevator equipment.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Production and Material Stocks in Ten Cities

### Steel Output Dropped 6 Per Cent, Lumber 12 Per Cent in Month—Cement and Brick Industries Suffer Fuel Shortage

**Steel**—Production of steel ingots in July totaled 2,487,104 tons, a drop of 6 per cent from the preceding month. The output for June, 2,634,477 tons was the peak of the season. Operations particularly with the Carnegie Steel Co. are proceeding at about 75 per cent of capacity. Transportation and fuel conditions have improved somewhat during the last week. Despite the usual seasonal dullness, demand for car materials, strip steel, sheets and plates continues active. Conditions in the semi-finished market, however, are more unsettled.

**Lumber**—An average of 369 mills reporting weekly to the National Lumber Manufacturers' Association for the four weeks ending July 22, 1922, show 845,928,489 ft. cut or a weekly average of 211,482,122 ft. as against 240,246,400 ft. during the preceding four weeks. Latest figures show shipments 10 per cent, production 6 per cent and orders 13 per cent below normal.

**Cement**—Output during June totaled 11,245,000 bbl., an increase of 69,000 bbl. over May, 1922, according to the Geological Survey. Shipments increased 721,000 bbl. leaving a reserve of 10,668,000 bbl. on July 1, 1922, a decrease of 2,225,000 bbl. from the preceding month.

**Brick**—Latest production figures as of July 1, received from 95 companies reporting to the Common Brick Manufacturers' Association of America, show 106,475,000 brick burned, or increases of 19 per cent in production and 21 per cent in shipments, and 115,333,000 shipped. Orders on the books are far in excess of both burned and green brick on hand as the brick table shows. This condition applies to all the Eastern and Middle Western districts. Stocks are adequate only in the South and Far West. At the outset of the strike brickyards were well stocked with fuel, but recent reports indicate that in many sections manufacturers are at the end of their supplies. Only one plant, in Illinois, is actually closed down for lack of fuel. For the first time in more than a year the brick industry is reporting a shortage of skilled labor.

**San Francisco**—Heavy supplies of road oils and cement; dealers' stocks of lime, brick, tile, sewer pipe and reinforcing bars in good shape. Only fair supply, however, of track supplies, expanded metal lath and triangle mesh. Plenty of structural shapes, plates and steel sheets; 25,000,000 ft. of lumber in yards.

**Denver**—Brick situation improved; supply limited but no delay in deliveries. Plenty of other building materials.

**Minneapolis**—Dealers' stocks of cement, brick, lime and hollow tile are low, orders being filled direct from cars or kilns in many cases. Mills are refusing to sell cement on large contracts, owing to fuel uncertainties. Lumber stocks fairly good at mills; little buying by dealers owing to uncertain deliveries. Lumber shortage expected soon if present strikes and weather conditions continue.

**Detroit**—Small quantities of paving stone, wood blocks and hollow tile on hand. Ample supplies of lime, brick and manila rope. Normal stocks of asphalt, sewer pipe and lumber, in yards. One cement mill closed down for lack of coal; others facing shutdown unless situation is relieved within thirty days. Car shortage has had no serious effect upon building materials supplies, as yet.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, Denver, 10,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta 24 @ 36 hr.); and stocks on hand in general terms, example: (common brick, New York, shortage.)

| | San Francisco | Denver | Minneapolis | Detroit | Chicago | New Orleans | Atlanta | Philadelphia | Montreal | New York |
|---|---|---|---|---|---|---|---|---|---|---|
| Sewer pipe | Well stocked | Del. 24 hr. local plant | | Moderate supply | 50 per cent below normal | Stocks low | Del. in 24 @ 36 hr. | Some kilns closed, acc't. of strikes. | Plenty | Enough for present demands. |
| Cement | Heavy stocks. | 10,000 bbl. | Mills refusing large contracts. | Warehouse stocks decreasing | Nearby mills; quick deliveries. | Enough. | 20 cars. | Plentiful. | Ample supplies. | Dealers stocks kept up. |
| Lime | Plenty | Ample supply. | Stocks low. | Prompt del. from Ohio and Michigan mills. | | | 30 @ 40 cars | Fair | Del. 24 hr. | Not yet affected by fuel situation. |
| Common brick | Enough | Small. No delay in del. from yards. | Scarce filling orders direct from kilns. | Enough for immediate needs | Stocks in yards, 100 per cent of capacity. | Sufficient to meet demands. | Plenty. | Del. from kilns as fast as produced. | Moderate | Shortage. |
| Hollow tile | Fair supply | Sufficient. | Stocks dwindling. | Stocks light; del. take several days. | Factories meeting demand. | | Del. 5 @ 6 days. | Production affected by strikes. | Del. 24 hr. | No shortage |
| Lumber | 25,000,000 ft. | Large stocks. | Fairly good at mills. | Normal | Enough | Demand heavy, stocks light. | Plenty at present. | Stocks depleted in some grades. | Large retail stocks. | 7 @ 8 week from mill. |
| Asphalt | Large stocks. | 10 cars. | | Sufficient. | | | Large supplies. | Heavy reserves. | | Refineries near city. |
| Structural steel | Good in spots. | | | | Supply not quite up to demand. | | 2 @ 3 cars. | | Well stocked. | Warehouse stocks heavy. |

REPORT ON COMMON BRICK FROM 95 YARDS AS OF JULY 1, 1922

| Dist. No. | Including States of | No. of firms reporting | Plants closed down | Burned brick on hand | Unburned brick on hand | Orders on books | Price per thousand at brickyard |
|---|---|---|---|---|---|---|---|
| 1. | N. Y., New England | 8 | 0 | 4,502,000 | 2,643,000 | 6,581,000 | $8.00 to $18.00 |
| 2. | Pa., N. J., Md., D. C., Del. | 11 | 0 | 12,088,000 | 5,879,000 | 35,355,000 | 12.00 to 18.00 |
| 3. | Va., N. C., S. C., Ga., Fla. | 7 | 0 | 3,306,000 | 3,933,000 | 8,013,000 | 9.00 to 16.00 |
| 4. | Mich., Ohio, W. Va. | 8 | 0 | 4,703,000 | 4,004,000 | 21,202,000 | 12.00 to 13.50 |
| 5. | Ill., Ind., Wis. | 25 | 1 | 123,371,000 | 2,439,000 | 199,874,000 | 10.50 to 14.00 |
| 6. | Ky., Tenn., Miss., Ala., Ark., La. | 11 | 0 | 6,613,000 | 5,444,000 | 9,075,000 | 8.00 to 16.00 |
| 7. | N. & S. Dak., Minn., Neb., Ia., Kan., Mo. | 9 | 3 | 2,917,000 | 2,801,000 | 3,429,000 | 10.00 to 18.00 |
| 8. | Okla., Tex., N. M. | 7 | 1 | 5,183,000 | 3,136,000 | 2,499,000 | 8.00 to 12.00 |
| 9. | Wash., Ore., Mont., Wyo., Ida., Utah., Colo | 4 | 0 | 1,687,000 | 340,000 | 339,000 | 13.50 to 16.00 |
| 10. | Calif., Ariz., Nev. | 5 | 0 | 3,380,000 | 7,245,000 | 7,905,000 | 14.00 to 15.50 |
| | | 95 | 5 | 167,750,000 | 37,864,000 | 294,272,000 | |

**Chicago**—Stocks of common brick in yards about 100 per cent of capacity. Hollow tile demand taking all that factories can produce. Sewer pipe supply about 50 per cent below normal and demand taking entire factory output.

**New Orleans**—Not enough sewer pipe. No crushed stone on hand. Lumber demand exceeding supply.

**Atlanta**—Plenty of lumber, brick and asphalt. About twenty carloads of cement, 30 to 40 carloads of lime and 2 to 3 carloads of structural steel on sidings. Deliveries made on sewer pipe in 24 to 36 hr.; hollow tile 5 to 6 days.

**Philadelphia**—Sewer pipe and hollow tile production curtailed by strikes. Local yards delivering brick from kilns before they are sufficiently cooled. Plentiful stocks of cement, lime, paving stone and wood blocks. Lumber stocks depleted; beginning to affect construction. Big reserves of ashphalt; South and Central West supplied from here.

**Montreal**—Deliveries made on lime and hollow tile in 24 hr. Cement and brick supplies sufficient to meet the demand. Plenty of sewer pipe and large retail stocks of lumber.

**New York**—Hudson River brick being shipped into market as fast as possible despite the fact that coal, wood and coke are almost unobtainable, except in limited quantities and at prohibitive prices. No actual shortage of other construction materials.

*"July Contracts 34 Per Cent Under Preceding Month"—p. 208, Business Side of Construction, Aug. 3 issue.*

*Maybe it didn't sound optimistic—but it was the truth.*

*That was why* Engineering News-Record *published it.*

*Could have said "July Contracts 13⅓ Per Cent Heavier than for July, 1921."*

*That also is true. But construction men are not so keenly interested in a year ago as they are in a comparison of "now" with only a month ago. They want to know the current trend.*

*So the* News-Record *cut to the line—let the chips fall where they might.* [*The Business Side of Construction tries to do this every week.*]

## Bid Prices on Federal Aid Roads Show Wide Ranges

Average accepted bids on Federal Aid road projects, during June, showed rates for common excavation ranging from 16c. in Texas to $1.39 per cu. yd. in New York. Bids on rock excavation reached as high as $3.64 in New England as against 35c. in Texas and 84c. per cu.yd. in Georgia. A wide range of bids on road projects involving the excavation of 8,295,786 cu.yd. of earth, resulted in an average rate of 34c. per cu.yd. for the whole United States. An average rate of $1.41 per cu.yd. is shown for 283,471 cu.yd. of rock excavation, for the entire country.

Prices of gravel, in varying quantities, ranged from 37c. in Iowa and 56c. in Colorado and South Dakota to $3.50 per cu.yd. in Georgia. Rates for sand maintained greater uniformity; the one high average being $2 per cu.yd. in Massachusetts as compared with 66c. in Texas and South Dakota and 26c. per cu.yd. in South Carolina. The highest rate for crushed stone, in place, was in New York, $3.70, with Ohio next, at $3.04; the minimum in Missouri, $1.50. Structural concrete costs were highest in Nevada and Washington.

STATEMENT OF AVERAGE ACCEPTED BID PRICES ON FEDERAL AID PROJECTS DURING JUNE, 1922.
ITEMS AND MATERIALS FURNISHED IN PLACE ON PROJECT.

| Geographic Divisions and States | Excavation: Common Cu.Yds. | Common Rate | Unclassified Cu.Yds. | Unclassified Rate | Rock Cu.Yds. | Rock Rate | Materials: Gravel Cu.Yds | Gravel Rate | Sand Clay Cu.Yds. | Sand Clay Rate | Crushed Stone Cu.Yds. | Crushed Stone Rate | Structural Concrete – Class A Cu.Yds. | Class A Rate | Class B Cu.Yds. | Class B Rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Totals for all States* | 8,295,786 | 0.34 | 1,983,391 | 0.65 | 283,471 | 1.41 | 785,318 | 1.48 | 92,016 | 0.46 | 142,609 | 2.34 | 39,560 | 19.60 | 24,061 | 17.60 |
| *New England* | 225,461 | 1.14 | 24,687 | 1.33 | 16,553 | 3.64 | 120,668 | 2.01 | 560 | 2.00 | | | 1,931 | 21.50 | 3,181 | 26.40 |
| Maine | 54,614 | 1.22 | | | 2,530 | 6.10 | 40,747 | 2.48 | | | | | 205 | 30.80 | 354 | 26.00 |
| New Hampshire | 33,398 | 1.02 | 9,692 | 1.41 | 746 | .... | 2,778 | 2.16 | | | | | 845 | 19.40 | 621 | 18.00 |
| Vermont | 47,224 | 1.01 | | | 1,687 | .... | 19,743 | 3.07 | | | | | 391 | 19.00 | 854 | 17.20 |
| Massachusetts | 90,225 | 1.21 | 14,995 | 1.27 | 11,590 | .... | 57,400 | 1.31 | 560 | 2.00 | | | 490 | 23.10 | 1,352 | 36.00 |
| Rhode Island | | | | | | | | | | | | | | | | |
| Connecticut | | | | | | | | | | | | | | | | |
| *Middle Atlantic* | 351,400 | 1.39 | 213,262 | 1.03 | 8,030 | 2.12 | 1,250 | 2.24 | | | 349 | 3.70 | 1,890 | 9.85 | 986 | 19.50 |
| New York | 351,400 | 1.39 | 116,100 | 0.97 | 8,030 | 2.12 | 1,250 | 2.24 | | | 349 | 3.70 | 1,760 | *8.60 | | |
| New Jersey | | | | | | | | | | | | | | | | |
| Pennsylvania | | | 97,162 | 1.08 | | | | | | | | | 130 | 27.30 | 986 | 19.50 |
| *East North Central* | 363,644 | 0.33 | 280,869 | 0.51 | 23,417 | 0.98 | 87,061 | 1.38 | 13,845 | 0.74 | 9,861 | 2.30 | 6,516 | 17.75 | 1,688 | 15.40 |
| Ohio | 6,271 | 0.62 | 280,869 | 0.51 | | | | | | | 741 | 3.04 | 2,398 | 18.30 | 1,216 | 14.70 |
| Indiana | | | | | | | | | | | | | | | | |
| Illinois | | | | | | | | | | | | | | | | |
| Michigan | | | | | | | | | | | | | | | | |
| Wisconsin | 357,373 | 0.32 | | | 23,417 | 0.98 | 87,061 | 1.38 | 13,845 | 0.74 | 9,120 | 2.25 | 4,118 | 17.50 | 472 | 17.10 |
| *West North Central* | 4,524,895 | 0.27 | 386,708 | 0.38 | 31,028 | 1.73 | 266,933 | 0.64 | 4,486 | 0.66 | 12,498 | 1.50 | 3,018 | 19.10 | 9,953 | 13.15 |
| Minnesota | | | | | | | | | | | | | | | | |
| Iowa | 1,226,560 | 0.27 | 107,720 | 0.51 | 7 | .... | 7,738 | 0.37 | | | | | | | | |
| Missouri | 605,522 | 0.36 | 116,106 | 0.37 | 22,176 | .... | | | | | 12,498 | 1.50 | 145 | 26.80 | 8,602 | 12.50 |
| North Dakota | 351,389 | 0.26 | 78,997 | 0.27 | 4,280 | .... | 34,625 | 1.29 | | | | | 650 | 19.30 | 169 | 20.00 |
| South Dakota | 46,170 | 0.33 | | | 100 | .... | 224,410 | 0.56 | 4,486 | 0.66 | | | 4 | 23.00 | | |
| Nebraska | 2,296,254 | 0.25 | 83,885 | 0.36 | 4,465 | .... | 160 | 3.00 | | | | | 1,232 | 19.20 | 1,182 | 15.60 |
| Kansas | | | | | | | | | | | | | 987 | 18.60 | | |
| *South Atlantic* | 495,743 | 0.37 | 76,754 | 0.51 | 11,119 | 1.08 | 2,106 | 3.50 | 6,673 | 0.31 | | | 4,895 | 20.00 | 1,741 | 17.60 |
| Delaware | | | | | | | | | | | | | | | | |
| Maryland | 82,600 | 0.59 | | | | | | | | | | | 70 | 21.40 | | |
| Virginia | | | 62,990 | 0.46 | | | | | | | | | 127 | 22.30 | 71 | 18.00 |
| West Virginia | 54,248 | 0.58 | 12,080 | 0.64 | | | | | | | | | 51 | 18.80 | 772 | 16.60 |
| North Carolina | 119,000 | 0.39 | | | 7,900 | 1.17 | | | | | | | 1,418 | 23.00 | 435 | 18.40 |
| South Carolina | 107,259 | 0.28 | 580 | 0.65 | | | | | 31,450 | 0.26 | | | 1,274 | 19.50 | 300 | 20.00 |
| Georgia | 132,636 | 0.21 | 1,104 | 1.58 | 3,219 | 0.84 | 2,106 | 3.50 | 25,223 | 0.36 | | | 1,955 | 17.30 | 163 | 15.00 |
| Florida | | | | | | | | | | | | | | | | |
| *East South Central* | 211,728 | 0.30 | | | 7,265 | 1.03 | 13,455 | 2.34 | | | 35,971 | 2.55 | 2,161 | 16.30 | 400 | 16.40 |
| Kentucky | 69,365 | 0.40 | | | 3,165 | 1.06 | | | | | 35,971 | 2.55 | 645 | 18.30 | 270 | 17.00 |
| Tennessee | | | | | | | | | | | | | | | | |
| Alabama | 46,717 | 0.33 | | | 4,100 | 1.00 | 13,455 | 2.34 | | | | | 703 | 17.10 | 130 | 15.30 |
| Mississippi | 95,646 | 0.22 | | | | | | | | | | | 813 | 13.90 | | |
| *West South Central* | 1,122,249 | 0.20 | 9,059 | 0.46 | 14,147 | 0.97 | 153,168 | 1.78 | 16,452 | 0.66 | | | 12,841 | 20.20 | 4,211 | 21.00 |
| Arkansas | 85,360 | 0.32 | | | | | | | | | | | | | | |
| Louisiana | | | | | | | | | | | | | | | | |
| Oklahoma | 374,005 | 0.24 | | | 13,747 | 0.99 | 6,081 | 2.82 | | | | | 5,583 | 21.80 | 3,851 | 21.20 |
| Texas | 662,884 | 0.16 | 9,059 | 0.46 | 400 | 0.35 | 147,087 | 1.74 | 16,452 | 0.66 | | | 7,258 | 18.90 | 360 | 17.80 |
| *Mountain* | 672,266 | 0.23 | 390,052 | 0.67 | 73,012 | 1.25 | 31,727 | 1.12 | | | 39,930 | 2.50 | 4,355 | 21.20 | 1,901 | 20.60 |
| Montana | 85,223 | 0.29 | 10,946 | 0.41 | 13,171 | 1.00 | 6,731 | 1.92 | | | 1,624 | 2.94 | 7 | 24.00 | 190 | 20.20 |
| Idaho | | | | | | | | | | | | | | | | |
| Wyoming | 430,000 | 0.20 | 287,600 | 0.79 | 24,200 | 0.92 | 8,600 | 1.50 | | | | | 2,386 | 21.00 | 771 | 20.80 |
| Colorado | 40,909 | 0.27 | 3,300 | 1.25 | 1,700 | 0.99 | 15,992 | 0.56 | | | | | 770 | 20.80 | 151 | 19.70 |
| New Mexico | 95,634 | 0.29 | 63,206 | 0.29 | 33,941 | 1.59 | | | | | 38,306 | 2.48 | 1,052 | 21.00 | 713 | 20.60 |
| Arizona | | | | | | | | | | | | | | | | |
| Utah | 20,560 | 0.50 | | | | | 404 | 1.70 | | | | | 60 | 15.00 | 61 | 15.00 |
| Nevada | | | 25,000 | 0.31 | | | | | | | | | 80 | 41.00 | 15 | 39.00 |
| *Pacific* | 327,400 | 0.40 | 602,000 | 0.74 | 98,900 | 1.22 | 108,950 | 2.56 | | | 44,000 | 2.27 | 1,953 | 24.70 | | |
| Washington | 45,000 | 0.30 | | | 35,000 | 1.20 | 20,600 | 2.04 | | | | | 15 | 40.00 | | |
| Oregon | 282,400 | 0.41 | | | 63,900 | 1.23 | 53,350 | 2.37 | | | 44,000 | 2.27 | 220 | 32.90 | | |
| California | | | 602,000 | 0.74 | | | 35,000 | 3.00 | | | | | 1,718 | 23.70 | | |

*Prices of items or materials containing State furnished cement and bitumen which was not included in total cost of the item are marked thus—*

## Coal Shortage Threatens Building Industry

### Several Steel Mills Will Close Unless Strike Is Settled Soon—Many Cement Plants Closed Down

The effect of the coal shortage on industrial operations, already noticeable in reports from New York stating that some of the large steel mills will probably have to shut down unless the coal strike is settled within the next few weeks, is also being felt by the cement industry and the difficulty of obtaining coal has caused a number of plants to cease operations for the time being. A statement issued by the Portland Cement Association in Chicago points out that the cement industry is the fourth largest consumer of coal in the country, over seven million tons being consumed at cement mills every year. Many of the mills have been having difficulty in securing coal for some time. With the regular source of supply shut off by the strike the mills have been forced to secure coal from more distant mines, at higher prices and a longer haul. As many of these sources are now cut off the situation has become acute and unless the strike adjusts itself in a few weeks more of the plants will be closed, or operated on part time.

Coming at a time when the country is experiencing one of the greatest building booms in its history, a shortage of cement would have a serious effect on every class of construction operation. As cement enters into practically every building that is erected the cutting off of the cement supply through the coal strike would tie up many of the building projects. A similar effect would be felt by the road construction industry, as cement is used in most of the highway programs.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 3; the next, on September 7.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb. | $2.83 | $3.65 | $4.00 | $2.68 | $2.95 | $3.60 | $3.10 | $3.75 | $3.75 |
| Structural rivets, 100 lb. | 3.60 | 4.35 | 5.50 | +3.25 | −3.52½ | +4.80 | 4.25 | 3.75 | 6.50 |
| Reinforcing bars, ¾ in. up, 100 lb. | 2.73 | 3.50 | 3.50 | +2.60 | 2.85 | −3.57½ | 2.55 | 3.60 | 2.90 |
| Steel pipe, black, 2½ to 6 in. lap, discount | 61% | 61.15% | 45% | 59½% | 61.9-5% | 46% | 49.1% | 53% | 30.00 |
| Cast-iron pipe, 6 in. and over, ton | +53.30 | 48.00 | 51.50 | −45.20 | 50.50 | 57.00 | 51.00 | 52.50 | 50.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.40@2.50 | 2.50 | 2.25 | 2.05 | +2.39 | −2.85 | 2.71 | 2.90 | 2.78 |
| Gravel, ¾ in., cu.yd. | 1.75 | 1.85 | 2.25 | 1.80 | 1.50 | 1.75 | 2.25 | +1.25 | 1.50 |
| Sand, cu.yd. | 1.00 | 1.15 | 2.25 | 1.80 | 1.00 | 0.75 | 1.50 | +1.25 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.75 | 1.90 | 2.73 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.00 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | +51.00@52.00 | +40.00 | 38.00 | 47.00 | 40.00 | −50.00 | 31.00 | −23.00 | +50.00 |
| Lime, finishing, hydrated, ton | 15.80@16.17 | 23.00 | 25 00 | 18.00 | 29.00 | 24.00 | 22.00 | 24.00 | 21.00 |
| Lime common, lump, per bbl. | 2.75@3.14½ | 1.80 | 2.50 | 1.40 | 1.40 | 2.70 | 1.75 | 2.80 | 11.00 |
| Common brick, delivered, 1,000 | 23.50 | 11.00 | 11.15 | 11.00 | 17@18 | 12.00 | 15.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, per block | Not used | +.0776 | .115 | +.0741 | .086 | .08 | .... | .11 | .09 |
| Hollow partition tile 4x12x12, per block | .1112 | +.0776 | .115 | .0657 | .... | .08 | .108 | .11 | .08 |
| Linseed oil, raw, 5 bbl. lots, gal. | −.91 | −.97 | 1.07 | 1.01 | 1.03 | +1.18 | 1.04 | .86 | 1.04 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .60 | .35 | ..... | .80 | ..... | .50@.55 | .56¼ | .50@.60 | ..... |
| Common labor, non-union, hour | .44@.60 | .30 | .25 | .72½ | .35@.50 | .35@.50 | .47½@.50 | .... | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

**New York** quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

**Chicago** quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

**Minneapolis** quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

**Denver** quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

**Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

**Dallas** quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

**San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

**Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

**Montreal** quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

## Changes Since Last Week

Structural rivets quoted at $3.25, as against $3.10, in Chicago, and at $4.80 as compared with $4.45 per 100 lb., in Denver, one week ago. New Minneapolis price based upon the Chicago quotation of $3.25, plus freight of 27½c., is $3.52½, against $3.53 last week. Reinforcing bars quoted in Chicago warehouses at $2.60 as against $2.58, and in Denver at $3.57½ as compared with $3.67½ last week. Steel shapes and reinforcing bars, $1.80@$1.90 per 100 lb., f.o.b. Pittsburgh, on bulk of current business. Quotations of $1.70, however, are made for large tonnages on contracts with regular customers. New inquiries for small tonnages quoted as high $2 per 100 lb. Mill shipments, New York, quoted at Pittsburgh price plus 34c., freight charges, or $2.04@$2.24 per 100 lb. Mill shipments of reinforcing bars quoted at $2.65 and structural rivets, $2.82½ per 100 lb., f.o.b. Denver.

Despite lull in lumber buying, price advances in some sections continue to equal declines in others. Yellow-pine structural timbers, base sizes, up $1 in Atlanta; fir up $3 in Montreal, down $1 in Denver, and 50c. in Seattle.

Fuel shortage is affecting hollow tile; price advances in Dallas and Atlanta.

Linseed oil down 2c. in New York; 1c. in Atlanta and advanced 2c. per gal. (5 bbl. lots) delivered in wooden barrels, in Denver.